TEXTILE RESEARCH

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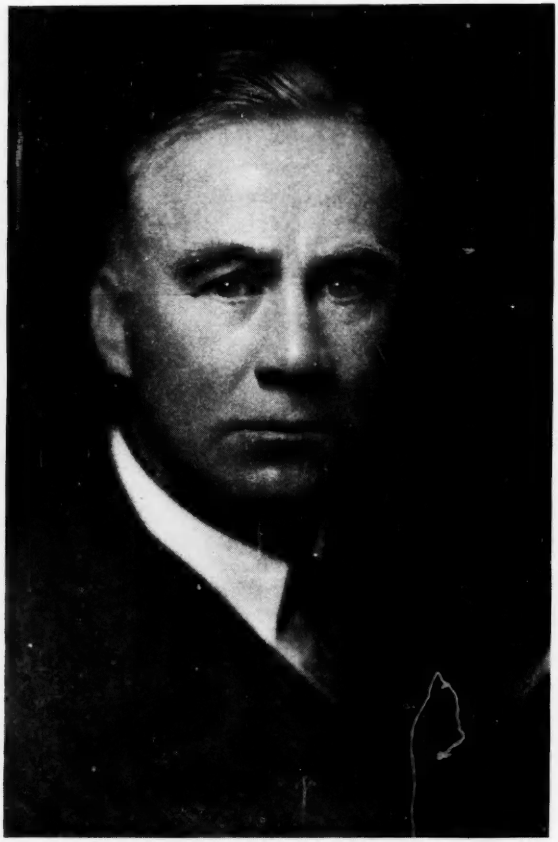

Francis P. Garvan

President, United States Institute for Textile Research, Inc.

November, 1931, to November, 1937

Died, November 7, 1937

Eighth Annual Meeting, Research Conference and Dinner

THE sudden death of President Francis P. Garvan only five days before the annual meeting cast a deep gloom over the proceedings, notwithstanding the efforts of members to carry on as he would have wished, and would have demanded had he known that the end was so near. Indirectly he had made such a demand, as it was announced at the meeting that it had been his intention to present his resignation as President, although with assurance of his unimpaired interest in the work and objectives of the Institute, and of his willingness to serve as Honorary President, as had been suggested.

Numerous tributes to his memory, and to the valuable services that he had given to the Institute, and to the research cause generally, were expressed verbally and by letter to Institute officials, and during the meeting of the corporation and at the banquet the audiences expressed their feeling of loss and respect by standing in silent thought.

The Board in behalf of the Corporation also adopted the following resolutions:

WHEREAS, in the death of Hon. Francis P. Garvan, the United States Institute for Textile Research lost not only its President but a leader who has contributed immeasurably to the advancement of textile research, and

WHEREAS, Mr. Garvan, during his six years as President has been largely responsible for the noteworthy growth of the United States Institute for Textile Research in that time, and

WHEREAS, the textile industry as a whole has been indebted to Mr. Garvan for his work with this Institute and for his sponsorship of the cellulose research laboratory at Boyce Thompson Institute for Plant Research and the graduate course in cellulose research at Massachusetts Institute of Technology, therefore

BE IT RESOLVED by the United States Institute for Textile Research at its eighth annual meeting in New York, November 12, 1937, that it record its deep sense of loss at the passing of Mr. Garvan, and

BE IT FURTHER RESOLVED, that a suitably engrossed copy of this resolution be sent to the family of Mr. Garvan, and that copies be released to the press.

The Meeting Program

THE annual meeting was originally called for the first Thursday in November, as provided in the by-laws, but it was found necessary to postpone the date to Friday, Nov. 12, to make possible the attendance of certain of the officers and speakers. The Hotel Commodore, New York City, was the place of meeting, rooms on the Ball Room floor being used for all functions excepting the dinner, and the latter being held in the East Ball Room.

The program for the various sessions was as follows:

11 A. M. Annual Meeting of Corporation. Acting-President, Dr. E. H. Killheffer, presiding.

12:30 P. M. Luncheon

1:30 P. M. Meeting of Board of Directors.

2 P. M. Open Research Conference, Subject: Textile Research Progress. W. E. Emley, Chairman, Research Council, presiding.

Warp Sizing. Dr. W. E. Yelland.

Textile Drying. Dr. J. G. Wiegerink.

Chemistry of Wool. Dr. Milton Harris.

Vat Printing Pastes. Dr. Sivert N. Glarum.

Some Industrial Applications of Textile Research. Bertil A. Ryberg.

7 P. M. Annual Dinner. Acting-President, Dr. E. H. Killheffer, presiding.

"Cellulose" Analyses. Dr. Wanda K. Farr, Cellulose Laboratory of the Chemical Foundation, Boyce Thompson Institute for Plant Research, Yonkers, N. Y.

Progress of Survey of Production and Distribution Organization in the Textile Industries. Dean Joseph H. Willits, Dr. C. Canby Balderston, Mr. H. S. Davis, Dr. George W. Taylor, Wharton School of Finance and Commerce, University of Pennsylvania.

What of the Future? Dr. Elvin H. Killheffer.

New Objectives and Plans Cause Postponement of Elections

AMONG the important features of annual meetings is the election by the Corporation of successors to the eight directors whose terms expire, the election of new officers and members of the Executive Committee by the Board of Directors, and the report of the Budget Committee. Action upon each of these items of the agendas for both meetings was postponed by unanimous votes to meetings of both bodies to be held on or about Feb. 15, 1938, the organization operating in the meantime with the existing officers, directors and Executive Committee, and with Executive Vice-President Killheffer as Acting President.

The reasons why the postponement of the actions noted would be found advisable were presented by Acting-President Killheffer under Items 7 and 8 of the agenda for the annual meeting of the Corporation, and were based upon the broadened objectives and plans for the future of U. S. Institute which he later outlined in his dinner address, and which are to be explained in more detail in a brief to be presented to the Textile Foundation.

Another action correlated with the postponement of elections and the proposed broadening of Institute objectives was the appointment of the following committee for such revision of the by-laws as may become necessary in this connection, this committee to be prepared to report any proposed revisions to the membership 30 days before they are to be acted upon: Alban Eavenson, Chairman; Dr. Robert E. Rose, Dr. H. DeW. Smith, W. E. Emley.

Dr. Killheffer as Acting-President was authorized by the Board of Directors "to draw up and present to the Directors of the Textile Foundation a copy of his plan covering new objectives of U. S. Institute for Textile Research, recommending that it receive their serious consideration."

The Board also voted to continue the Budget Committee (Dr. H. DeW. Smith, Chairman, F. S. Blanchard, C. H. Clark) for further study, their report to be made available to the Committee on Revision of By-laws, but not for publication until accepted by the Board.

Other important actions of the Board included adoption of the recommendation of the Research Council to continue the research on warp sizing, and the following new ruling increasing research services available to Annual members:

"Voted: That we adopt the recommendation of the Research Council that progress reports of co-operatively financed researches shall be made available to members of U. S. Institute for Textile Research, Inc., for publication in Textile Research or otherwise after one year has elapsed since these progress reports were made available to co-operators of such researches."

Minutes of Annual Meeting of Corporation

PURSUANT to a call mailed to members Oct. 21, the annual meeting, postponed by order of Executive Vice-President Killheffer from Nov. 4th to Nov. 12th, 1937, was held at the Hotel Commodore, New York, N. Y., on the latter date, and was called to order by the Executive Vice-President at 11:30 A. M., the following members being present in person and constituting a quorum: A. G. Asheroft, F. S. Blanchard, C. H. Clark, D. E. Douty, Alban Eavenson, W. E. Emley, Franklin W. Hobbs, Ernest N. Hood, E. H. Killheffer, R. E. Loper, L. A. Olney, J. T. Power, D. H. Powers, J. B. Quig, R. E. Rose, H. V. R. Scheel, E. R. Schwarz, H. DeW. Smith, H. A. Stafford, P. J. Wood, D. G. Woolf.

Agenda

1—Minutes of last meeting.
2—Report of Board of Directors.
3—Report of Treasurer.
4—Report of Auditor.
5—Report of Secretary.
6—Report of Research Council.
7—Report of Nominating Committee.
8—Election of Directors.
9—New Business.

The agenda for the meeting was then acted upon as follows:

1—The minutes of the last meeting (Nov. 5, 1936), having been received by all members, it was duly moved, seconded and voted: That reading of the minutes of the last meeting be dispensed with and that they be accepted and filed.

2—The annual report of the Directors and Executive Committee, having been read by the Secretary, it was duly moved, seconded and voted: That the annual report of the Directors and Executive Committee as read be accepted, and placed on file.

3—Voted: That the annual report of the Treasurer as read by Mr. Hodd be accepted and placed on file.

4—The report of the Auditor (Robert Dysart, C.P.A., Boston, Mass.) as read by Treasurer Hood, was as follows: "I have examined the cash book, bank records and vouchers of the United States Institute for Textile Research, Inc., for the fiscal year ended Sept. 30, 1937, and submit the following exhibits, as made up from the records presented:

"Exhibit 'A,' Cash statement, current fund, year ended Sept. 30, 1937.
"Exhibit 'B,' Permanent Fund, year ended Sept. 30, 1937.
"Exhibit 'C,' Balance Sheet, as at Sept. 30, 1937.

"Current Fund cash receipts as charged have been duly accounted for, and the disbursements have been substantiated by cancelled paid checks and bank charges, together with the vouchers produced by the office. The closing bank balance and cash book were reconciled with reservation for

Report of the Treasurer, Year Ending October 1, 1937

Receipts		Disbursements	
36 Contributing Memberships	$ 3,528.00	Salaries	$ 5,564.14
191 Annual Memberships	1,528.00	Rent	360.00
TEXTILE RESEARCH Magazine	4,016.78	Magazine	3,244.98
Warp Sizing Research	5,662.49	Warp Sizing	4,586.11
Drying Research	4,225.00	Drying Research	922.91
Misc. Receipts	286.14	Office and Misc.	1,740.47
	$19,246.41		$16,418.61

Balance Oct. 1, 1936			Balance Oct. 1, 1937		
General Funds	$1,956.74		General Fund	$ 406.07	
Warp Sizing	221.94		Warp Sizing	1,298.32	
Drying Research	300.00	2,478.68	Drying Research	3,602.09	5,306.48
		$21,725.09			$21,725.09

Warp Sizing Account

Receipts		Disbursements	
Balance, Oct. 1, 1936	$ 221.94	Expenditures	$4,586.11
Receipts	5,662.49	Balance, Oct. 1, 1937	1,298.32
	$5,884.43		$5,884.43

Drying Research Account

Receipts		Disbursements	
Balance, Oct. 1, 1936	$ 300.00	Expenditures	$ 922.91
Receipts	4,225.00	Balance, Oct. 1, 1937	3,602.09
	$4,525.00		$4,525.00

Balance Sheet Oct. 1, 1937

Cash, Second National Bank	$5,306.48	Permanent Funds	$2,000.00
Cash, Salem Savings Bank	1,190.23	Interest available for use	438.02
Cash, Salem 5¢ Savings Bank	1,247.79	General Funds	406.07
		Warp Sizing	1,298.32
		Drying Research	3,602.09
	$7,744.50		$7,744.50

outstanding checks. Attention is drawn to the fact that the vouchers have not been approved for payment in accordance with the provisions of Article VIII, Section (7) of the By-Laws."

It was then duly moved, seconded, and voted: That the report of the Auditor be accepted and placed on file.

5—The annual report of the Secretary having been called for he stated that he had little that could be added to the report of the Directors and Executive Committee excepting additional details, but that he was ready to answer any queries as to the latter. There being no questions this item was passed over without action.

6—Chairman Emley of the Research Council reported verbally as follows: "Researches conducted by the Institute have been described in the report of the Board of Directors; the financial status has been described in the Treasurer's report, and the work itself will be discussed in considerable detail this afternoon and evening. I wish everyone would be present at the afternoon and evening meetings to get details of the work which has been done."

Voted: That the report of the Research Council be accepted and filed.

7, 8—Instead of asking for the report of the Nominating Committee (Messrs. Emley, Eavenson and Smith), Chairman Killheffer spoke as follows: "I hope to discuss at considerable length this evening a quite definite plan or objective toward which we would like to work. Should we have any measure of success at all in attaining the new objective it would very likely necessitate a recasting of our organization in many respects. In view of that it would seem best to defer at this time the election of new directors, and new officers also, for a period of perhaps 90 days. All of you I think who have been keeping in close touch with the work of the Institute have been both gratified and disappointed. We have been happy that we have accomplished anything in the rather haphazard method that we had to go about it, and at the same time we have been disappointed that we haven't been able to establish a larger and more effective operation.

"With that as a background I believe we are all interested in some change or different plan if we find one that we think has any chance for success. The reason I am proposing that we pass the matter of nominations is simply that we preserve the status quo for a period until we can explore more thoroughly the possibility in this new plan and see whether there is any possibility of doing anything or not. We shall need considerable re-casting of our set-up. With that explanation I would appreciate it if you would ask questions if you want to know more about what we have in mind, or would take my word for it, and would move that we defer the election of new directors to an adjourned meeting of the membership to be called about Feb. 15."

It was then moved, seconded, and voted: That the nomination and election of Directors whose terms were due to have expired at this meeting, or have resigned, be deferred for action for 90 days to an adjourned meeting of the Corporation to be held about Feb. 15, 1938.

9—Under New Business Chairman Killheffer stated: "I should like to appoint a committee who can be giving some study to our present by-laws which I think need some revision, particularly the different classes of membership. Then, whatever revision may seem to be required either in our present organization or in a re-casting of it presumably will be ready in

time to provide for revision in by-laws to be reported to the membership 30 days before they are to be acted upon. I would like to appoint on that committee: Alban Eavenson, Dr. R. E. Rose, Dr. H. DeW. Smith, W. E. Emley."

Chairman Killheffer then stated that: "It seems fitting that we in some way at this and other meetings to follow express our sense of deep loss in the passing of our President. A number of us attended his funeral services on Wednesday. We feel, and I do particularly, that we have sustained a very real loss. His enthusiasm was of the kind that is contagious. Personally I feel also that I have sustained quite a loss in the activities of this day. I was counting rather heavily on the support that he might give me in the plea that I might hope to make for a new and greater activity on our part. I would propose that at this point we rise for just a moment out of respect for the memory of our President, Mr. Garvan. (Members rose, and stood silently for a moment.)

There being no further business, the meeting was declared adjourned at 12:30 P. M.

Annual Report of Board of Directors

YOUR Board of Directors held three regular quarterly meetings during the fiscal year 1936–37: Nov. 5, 1936, and March 16 and Sept. 29, 1937; the Executive Committee held two meetings: June 15 and July 20. All of the meetings were in New York City. All of the directors and officers who were elected at the last annual meeting, Nov. 5, 1936, accepted.

Your books of account have been audited by Robert Dysart, C.P.A., and his certificate of their correctness has been accepted and filed. There was a marked increase in receipts, due largely to an increase in Contributing members for co-operatively financed researches. There was a corresponding increase in expenses or reserves for such researches, and expenses were also increased by the cost of a special membership campaign. Cash reserve as of Oct. 1 for the warp sizing project, whose fiscal year ends Dec. 31, was $1,298.32; that for the drying project, whose fiscal year ends May 31, 1938, was $3,602.09. In addition we closed our fiscal year with a small cash balance of funds not ear-marked for specific researches.

Researches in Progress

Organization of the textile drying research was completed during the year under review, and actual work was started at the National Bureau of Standards in July. This study is wholly financed for a year at $5,000 by 50 co-operators who have received Contributing memberships in U. S. Institute.

The warp sizing research, which has been in progress at Mass. Institute of Technology since May, 1935, was re-financed as of Jan. 1, 1937, with the aid of the Textile Foundation, which renewed a grant of $2,500 for a year, and 25 co-operating Contributing members of U. S. Institute. Continuance of this study for another year, dependent upon our ability to re-finance it, has been recommended by the Research Council.

The Survey of Production and Distribution Organization in the Textile Industries, which is wholly financed by the Textile Foundation at

$20,000, and has been in progress at the Wharton School of Finance and Commerce, University of Pennsylvania, for more than a year, is now nearing completion and will be published in book form. U. S. Institute's Committee on Economic Research suggested and planned this study, secured the financial support of the Textile Foundation, and the moral support of the heads of 14 leading textile associations, and with a committee of four of the latter has acted in an advisory capacity to the Wharton School.

These three types of research organization are encouraging examples of textile co-operation. Your Board of Directors, however, frankly acknowledge that this program of research, together with that of the Textile Foundation, the Chemical Foundation and the American Association of Textile Chemists and Colorists, inadequately meet the needs of the great textile industry. They pledge themselves to further constructive effort to rectify this situation, and crave the co-operation of the members of those organizations, as well as of our members, in this work. We commend to your thoughtful consideration the address of Dr. Killheffer to be delivered at our dinner this evening. It presents a research plan needing and meriting the co-operation of every textile organization and individual interested in providing the fundamental knowledge which is basic to more efficient textile processing and to new finishes and products.

Among the most important actions of your Board and Executive Committee during the fiscal year under review were several having for their objective the clearer definement of the duties and authorities of the Research Council, the Administration Committees for co-operatively financed researches, the Treasurer and the Secretary in connection with researches that are co-operatively financed. These were largely the result of constructive suggestions made by the Research Council and the Administration Committee for the textile drying study.

Increased Services to Members

Our membership has increased to a new record of 114 Contributing and 194 Annual members; with two Life members this is a total of 310, comparing with 265 a year ago. The gain of 45 members is wholly in the Contributing class, and is due to the fact that this class of membership has the privilege of receiving the advance progress reports of either one of our two co-operatively financed researches: Warp sizing or textile drying. Both classes of membership are ridiculously small as compared with what they should be, and should be justified by the valuable services provided to individual members at a fraction of their total cost. Hereafter a valuable new service will be made available to Annual members and should largely increase the total. This is the publication in TEXTILE RESEARCH of reports of results of co-operatively financed researches that were received by co-operators a year or more previously. At present this new ruling will make available only the first three or four progress reports of the warp sizing study, but eventually this service to Annual members should be out of all proportion to the annual dues of $10.

There is one special service rendered to members by the magazine that has shown marked expansion during the year, and that is the privilege of receiving photostat or other complete copies of articles abstracted. The character and limitations of this service are explained on the first page of the Abstract Section of each issue. Efforts are being made constantly

to improve this service. Approximately 1,000 abstracts were published in the current volume, and during the last few months more than 100 complete copies of articles abstracted were inquired for.

Both as a result of the increase in Contributing members, who qualify to have any five of their representatives receive the magazine, TEXTILE RESEARCH, and the increase in non-member subscriptions, our monthly mailing list is now about 800 copies, as compared with 632 a year ago. Copies going to non-members on subscriptions number 139, of which 87 are domestic and 52 foreign.

Tribute to President Garvan

The most important item to which your Board of Directors directs your attention is the death of our President, Mr. Garvan. His service to this Institute was manifested in many ways. His unfailing advice and counsel, his substantial financial aid through the Chemical Foundation of which he was President, and the contribution of the services of Mr. Buffum, who already had more demands on his time than he could take care of, were all evidences of deep interest and abiding faith in the work of this Institute.

Appreciation of Contributed Services

We record our appreciation of the grants of The Textile Foundation for the complete financing of the economic study at the Wharton School of Finance and Commerce, and for 50 per cent of the financing of the warp sizing study for the current year; also for continuation of the financial support that makes possible publication of TEXTILE RESEARCH.

We extend our thanks to the National Bureau of Standards, the Massachusetts Institute of Technology and the Wharton School of Finance and Commerce for making available for the researches previously mentioned their facilities and the co-operation of their staffs.

We also record our appreciation of the services contributed by the members of the Committee on Economic Research, and of the Administration Committees for the warp sizing and the drying researches, several of whose members are not members of U. S. Institute.

Open Research Conference

FOR several years the Research Council has held a conference in conjunction with annual meetings to which all interested in textile research are invited. Several of these open conferences have been devoted to papers and discussions on subjects that had been selected for or adopted by the Council for research. The researches on warp sizing and on textile drying were approached in this way.

The open conference, held in conjunction with this meeting in Parlors B and C of the Commodore, was devoted to a series of papers and talks by research associates of U. S. Institute and of the American Association of Textile Chemists and Colorists reporting progress of their researches. It was in effect but one of two sessions covering the main topic of the annual meeting: "Progress of Textile Research." The second session was the speaking program at the annual dinner, during which Dr. Farr reported on progress of the Chemical Foundation's research on the chemistry of cellulose, and Dean Willits and associates on the Textile Foundation-U. S. Institute study of integrated textile manufacturing and merchandising.

Chairman W. E. Emley of the Research Council presided over the conference which opened at 2 P.M., with an audience of 75 present. In introducing Dr. W. E. Yelland, director of U. S. Institute's research on warp sizing, and Dr. J. G. Wiegerink, director of the Institute's study of textile drying, Chairman Emley called attention to the fact that these are both co-operatively financed researches, the progress reports of which are available for a year only to those firms co-operating in the financing. Both speakers, therefore, would be obliged to confine their remarks to rather general terms as to results, but could explain in some detail the programs on which they are working. Dr. Yelland's extemporaneous remarks are published. Dr. Wiegerink, when called upon, merely noted that his work on the textile drying research, which started at the National Bureau of Standards in July, had been confined to a study of the literature of the subject, the development of the program and the apparatus for the initial research.

Chairman Emley then called upon Prof. Louis A. Olney, Chairman, Research Committee of the A. A. T. C. C., and also a director of U. S. Institute, to introduce the three Research Associates of the A. A. T. C. C. who he had kindly arranged to be present and to report on the progress of their studies. Prof. Olney explained that all of the A. A. T. C. C. research work is public, with progress reports published in the official organ, the *American Dyestuff Reporter*. He also stated that, following presentation of their papers, each of the Research Associates would be pleased to answer queries, or engage in discussion.

Dr. Milton Harris, who has been directing the research on the Chemistry of Wool at the National Bureau of Standards for several years, was the first speaker. He spoke extemporaneously and illustrated his remarks on a blackboard. Unfortunately, only a brief outline of his talk is

available for publication in this issue, but those desiring more complete details may be referred to reports that have been and will be published in the *American Dyestuff Reporter* and in the *Journal of Research* of the National Bureau of Standards. Following Dr. Harris' address he answered numerous queries, and Prof. Olney called upon Alban Eavenson, Chairman of the A. A. T. C. C. sub-committee for this study, to comment on the work. Mr. Eavenson referred to the value of the new fundamental results of the study, as well as to the results having practical application.

The paper of Dr. S. N. Glarum on "A Fundamental Study of Vat Printing Pastes," and that of Bertil A. Ryberg on "Some Industrial Applications of Textile Research," which are published in this issue, were also followed by interesting discussion. At Prof. Olney's request Chairman W. H. Cady of the A. A. T. C. C. sub-committee on textile printing pastes commented briefly on Dr. Glarum's paper, as did Chairman Hugh Christison of the sub-committee in charge of Mr. Ryberg's work, on the latter's paper.

Following completion of the formal program Prof. Olney spoke in some detail of the research work of the A. A. T. C. C., referring also to the generous financial support of the Textile Foundation, but noting that present and prospective research needs are far in excess of the funds available for their financing.

Chairman Emley then resumed the chair, and stated that the meeting was open for suggestion of subjects needing research that might be referred to the Research Council and to a future open conference for consideration. Receiving few definite suggestions he stated that they could be mailed to him at any time. After thanking Prof. Olney and the speakers for their contributions to the conference, he called for a rising vote of thanks, and that being given, the meeting was declared adjourned at 4:30 P.M.

Warp Sizing Project

By DR. W. E. YELLAND

IN the time at my disposal it is possible to present only a limited survey of the program of the Warp Sizing Project since its beginning in June, 1935, and to discuss briefly plans for further work.

The program as originally conceived was very comprehensive in that it was intended to cover the whole field of warp sizing including not only synthetic yarn but also cotton and worsted. At a meeting of the committee and contributors early in 1936 it was decided to concentrate the investigation on synthetics, especially viscose rayon. As representative of this type of material 150 denier 40 filament bright viscose was chosen. Many of the results obtained in the study of this filament yarn are capable of direct application to other types of yarn; some results, however, will have to be modified by further work. It is planned to extend the research into the field of spun rayon as soon as feasible.

The work accomplished to date may be classified under two headings: (1) Laboratory work; (2) field work, or experimental research on mill scale.

The laboratory investigations have dealt with the materials used in sizing and with the properties of the yarn before and after slashing.

Gelatins and glues are used most extensively on viscose, but soluble starches, gums, oils and synthetic materials are important and cannot be

neglected. Representatives of all these classes of materials have been investigated in the laboratory as to their physical and chemical properties and behavior under the conditions met during warp sizing. New samples will be investigated as representatives of different classes are obtained.

Films made from these materials are being studied in the hope that they will afford clues to the behavior of similar films of size on the yarn during weaving. The results so far obtained are promising.

Sized yarn differs from unsized in physical characteristics such as breaking strength, residual elongation at the break, cohesion, and stiffness. These have been studied in the laboratory and it was pointed out in report No. 4 that while some of these characteristics are related to the size on the yarn, others are functions of the method of application of the size.

It was necessary to study the size distribution on the yarn in order to determine whether coating of the yarn or penetration was being achieved. This necessitated the development of a technique for differentiating gelatin and glue from the viscose so that the size is visible on sections viewed under the microscope. This technique was given in detail in report No. 6.

In this connection an improved method of embedding fibres and fabric for cross-sectioning work has been developed by means of synthetic resins. The method offers many advantages over older methods and has proved of value in the field of pile fabrics. The report on this method has not yet been released.

Some factors are not adapted to a study under laboratory conditions. These are: size application; evaluation of sized yarn on the basis of its performance in the loom during weaving.

In slashing there are mechanical factors in addition to the size itself which affect size application. These are: stretch, speed, condition of squeeze roll (blanketed on base), squeeze roll pressure, rate and intensity of drying. They cannot be duplicated satisfactorily in the laboratory.

The warp sizing project is fortunate in having available for field work a very well equipped 7-can rayon slasher. In addition to the usual controls on stretch, squeeze roll pressure, etc., this slasher has been equipped with size level control, size temperature control, and drying control. These last three controls have been loaned to the Warp Sizing Project by one of the instrument firms contributing to the research. This firm has also given considerable technical assistance in installing, adjusting and adapting the controls for the warp sizing study. This installation has taken several months. We now have the opportunity to slash on mill scale, but under conditions which are much more carefully controlled than is usual in the mill.

Tests are now under way on a series of warps to investigate the regain to which rayon should be dried after slashing and to study the effect of using different grades of gelatin and glue in slashing. These tests involve the preparation and testing of 24 warps, each 2,300 yards in length. Hence the weaving and laboratory tests will occupy several weeks.

While the work was in progress on the installation and adjustment of controls on the above mentioned slasher we were given the opportunity to study the slashing and weaving of 18 rayon warps to be used as pile warps in weaving transparent velvets. On these were used three grades of gelatin, two types of converted starch, a gum, an oil size, and a synthetic resin. Two reports on these tests, No. 7 and No. 8, have already been received by cooperators, and others are in preparation.

The work of the project has now reached a point where more emphasis can be placed on mill scale investigations than heretofore. The use of a modern slasher equipped with some of the best controls available affords an opportunity to slash under conditions such that the number of variables is greatly diminished. Thus it should be possible to weave warps with some assurance that the results obtained in weaving may be traced to definite factors in the warp preparation and slashing.

In order to keep the contributors better informed as to the progress of the work reports will be issued at shorter intervals. These reports will be briefer and will be based more on the results obtained from actual slashing and weaving tests than formerly.

The Chemistry of Wool

By DR. MILTON HARRIS *

IT is the purpose of this talk to discuss the chemistry of wool and similar substances, both from the standpoint of practical wool processing and from the part these materials play in our every-day life.

Wool belongs to a class of proteins known as the keratins. These materials are characterized in general by a high sulfur content, practically all of which is present in the form of amino acid cystine, and by their great resistance to bacterial and enzyme attack. Because of their great stability they are considered as protective tissues, and it is interesting to note that nature has provided the human and animal bodies with an abundance of keratin in the form of hair, finger nails, epidermis, etc. The sulfur containing amino acid, cystine, has been found to have an important rôle in the studies relating to arthritis, diabetes, and cancer research. As a result, a great amount of research has been done on this compound and it has been shown, for example, that alteration of the state of the sulfur in insulin drastically alters the physiological activity of this material for diabetic treatment.

The results of a research program on the chemistry of wool, which is being done at the National Bureau of Standards for the American Association of Textile Chemists and Colorists has indicated a similarly important rôle for sulfur in wool research. Protein chains in the wool molecule appear to be linked together by sulfur in the form of disulfide groups which account for a considerable portion of the stability of the wool molecule. However, it has been shown that any reagent which will alter the state of these disulfide groups, will alter or destroy the physical structure of the fibre as a whole. In general, these groups are extremely susceptible to attack by oxidizing and reducing agents, light and alkalies. It is possible under suitable conditions to oxidize wool so that from all outward appearances, it is practically unchanged and yet the incipient damage in the wool may be so great as to render the wool nearly worthless. The methods which were worked out for the study of oxidized wool may be utilized in the control of practical bleaching, chlorination, and bromination processes.

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From the standpoint of such practical processes as dyeing and carbonizing, the researches on the acid and basic properties of wool have been most fruitful. The acidic groups account for the absorption of alkalies and basic dyes by wool, whereas the basic groups react with acids and acid dyes. The acid dyeing process has been shown to be governed by simple chemical laws. Treatment of the fibre with reagents which decrease its basicity correspondingly decreases the affinity of wool for acid dyes.

Alterations of the acidic and basic properties of wool are manifested in changes in the surface electrical charges of the fibre and are readily measured with an electrophoresis cell. This apparatus, which has long been used in researches in blood cells, tissues and other biological surfaces, is proving to be very useful in studying the surface properties of textile materials.

A Fundamental Study of Vat Printing Pastes

By DR. SIVERT N. GLARUM *

THIS project of the American Association of Textile Chemists and Colorists is entitled A Fundamental Study of Vat Printing Pastes. We have tried to adhere strictly to the purpose expressed in this title and make the study deal solely with the fundamentals of vat printing.

The process of printing vat colors consists of three quite distinct operations, first, the preparation of the printing color, second, the application to the cloth, and third, aging and oxidation of the dye. A preliminary survey made it apparent that it would not be possible to study the entire process at once as such a great number of variables were involved. It was decided, therefore, that the preparation of the printing colors should be the first subject to be studied. The other operations have been taken up as the work progressed.

"What are the necessary physical properties of a good printing color?" is the question asked of a number of printers. As a result we were informed that the colors should be thick, but not too thick; long, but not too long; tacky, but not too tacky, etc. The final answer of the printer in each case was to stir a tub of printing color with a stick and observe the manner in which the color flowed as the stick was raised. From this observation the color was described as being good, fair, or poor according to the individual's experience.

It was apparent from this that the very first objective of this study must be to answer the question, "What are the necessary physical properties of a good printing color?"

All the replies to the above question involved the flowing properties in some manner or other, so the measurement of these properties by a simple but accurate method became the first aim of the project. Although a number of unsuccessful attempts had been made previously to correlate the viscosities of printing colors with their printing qualities, it was decided that further experiments were worthwhile. The first conclusion was that printing colors must be treated as pseudoplastic materials, so that ordinary viscometric measurements are of no value in studying their flow-

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ing characteristics. Materials of this class do not possess a true viscosity. Their apparent viscosity depends to a great extent on the conditions under which it is measured. The viscosity of a liquid such as castor oil is constant regardless of the stress applied. The apparent viscosity of a pseudoplastic substance may vary a hundred fold with comparatively slight changes in stress.

For measuring the flowing properties of printing pastes a method, which was suggested by some work done on paints, has been developed. The apparent fluidity of a sample is measured at a series of stresses and the data is plotted to obtain the flow curve. This curve presents an accurate picture of the flowing characteristics of that sample. It shows not only the apparent fluidity at varying stresses, but the rate of change of fluidity with stress which is of much greater importance for many applications.

Using this method it has been possible to show the characteristic flowing properties and interpret the behavior of a wide variety of materials which could not have been done otherwise.

With the development of this method the problem of determining the necessary properties of a good printing color was attacked. Several hundred samples of printing colors and the prints produced with them were collected from a number of print works. In order to limit the number of variables as much as possible, colors were selected which were being used on small designs such as fine lines. The prints were graded as good, fair or poor on the basis of the accuracy of reproduction of the pattern engraved on the printing roller. The flow curves of the colors were measured as previously described. It was found that the flow curve of every color that produced a good print fell within very definite limits of fluidity. The further the curves were beyond these limits, the poorer were the prints produced. It was felt then that we had the answer to our initial question. While the limits established were for a definite type of printing, the method is adaptable to the establishment of such limits for any class of work.

It is no longer necessary to describe the properties of printing colors as long or short, thick or thin. The determination of the flow curve gives an accurate and reproducible measurement of its flowing properties that can be understood by anyone, experienced or not.

Thickeners

The next phase of this investigation was to determine how to produce colors possessing these flowing properties.

Besides the dyestuff, a printing color contains one or more thickening materials, a reducing agent, some alkali and a variety of other materials which are added to alter the working properties of the color. Since this was to be a fundamental study only the essential ingredients have been considered in detail. The effects of the various assistants will be studied later.

The thickeners in a printing color are almost solely responsible for the flowing characteristics of the color. The other constituents are concerned in this respect only as they may affect the properties of the thickeners. The "color yield" is also greatly influenced by the thickener used in the color.

The principal types of thickeners are the starches, British Gums and the natural gums. The flow curves of pastes made with these materials

have shown that each possesses certain characteristics peculiar to itself. In mixtures the properties are additive to a certain extent so that it is possible to produce pastes of almost any desired flowing characteristics.

Since this was a fundamental study, a rather fundamental and long-used thickening was chosen to be studied first. This is a mixture of equal parts of corn starch and a highly soluble British Gum.

Any study of thickeners is largely a study of the methods of preparing the pastes and the present study is no exception. The effects of the temperature, length of time and the concentration of cooking have been studied as well as the effect of adding the alkali at different stages. To sum up the results very briefly, it was found that the more thoroughly the starch-British Gum mixture is cooked the greater is the thickening value and the greater the "color yield." The addition of the alkali after cooking also produces a paste with greater thickening value than if the alkali is cooked in the paste.

This study is far from complete and only a few of the vast number of thickeners have been investigated. The work is being continued at Brown University by Dr. Gleysteen and it should lead to a better understanding of the whole subject of thickeners.

Ageing

The mention of the subject of ageing seldom fails to evoke at least a smile from the listener. Much has been written and spoken on this subject but there is little factual information available. After making the usual measurements of temperatures and analyzing vapors in plant agers it was obvious that a fundamental study of this operation was also necessary. This study has just been started and no results are available. Prof. E. K. Strachan at Brown University has taken an active interest in this investigation, and with his co-operation an apparatus has been constructed so that accurate measurements may be made on printed or unprinted goods under conditions duplicating those occurring in plant agers. Much valuable information should result from this study.

It is realized that the results obtained so far by this project go only a little way toward solving the many problems concerning printing. New products and problems arise daily and these alone could occupy the full time of such a study. The purpose of a fundamental study such as this is to lay a groundwork which will make it possible to make a more efficient and intelligent use of the materials which are available.

Some Industrial Applications of Textile Research

By BERTIL A. RYBERG *

RESEARCH, in order to be supported by industry, must show a practical value, which may be represented by new products, new methods, improvement of existing products or methods, or lowered costs of manufacture.

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The textile industry, which at present is not overburdened with profits, has been slow to support fundamental research, particularly when its practical value may not be proven for some time. Yet, other industries, notably the electrical, automobile and chemical, have proven the value of long range fundamental research. These industries might be considered new in comparison to the textile industry. Textile research has also proven its value as will be shown by the following examples.

Some of the early work of the American Association of Textile Chemists and Colorists gave us methods for testing the fastness of dyestuffs to the various color destroying agents, such methods of testing making it possible to improve the fastness properties of existing dyestuffs and also, to test new dyestuffs or combinations of existing dyestuffs. A machine, known as the Launderometer, was developed for use with many of the tests promulgated and standardized.

Fastness of Dyes to Fulling

Among the many tests was one for testing the fastness of dyestuffs to fulling or felting. This consisted of braiding together the colored yarn with white yarn and immersing in a soap solution for 16 hours. It was then heated and rubbed on a washing board to produce felting, then rinsed and dried. This compared favorably with a two-hour fulling.

Most tests to be of greatest value should be accelerated tests; that is, to be able to duplicate certain results in one-half or less time than that needed in actual performance. In the above case, the test was taking a great deal more time than an actual mill fulling and also the mechanical action of fulling was practically absent. The need of an accelerated test for fastness to fulling, which would duplicate as nearly as possible the mechanical action of a fulling mill, was apparent.

The Launderometer was selected as being the most suitable means of providing mechanical action so necessary for producing a felt. Woven fabrics were first tried with little success and after considerable work with fibrous masses and so forth, a knit fabric was tried and found to be the most satisfactory of any. Considerable work was done before the proper type of yarn and size of knit tubing were finally settled. A method was finally evolved and adopted as standard by our Association and it is published in our Yearbook.

Results of Proved Value

The value of this method has been proven and it is in actual use daily by woolen and worsted manufacturers and dyestuff manufacturers. It affords a means for studying the behaviour of new dyestuffs and mixtures without the risk of losses on a large scale.

Our Association manufactures the standard knit tubing used in this test. The value of this method is demonstrated by the fact that there is a continual demand for tubing from a variety of sources.

Study of Carbonizing Process

Another phase of our activities dealt with the carbonizing process, a process by which vegetable matter is removed from wool. This process has

been in use a long time, but with varying results. The greatest difficulties occurred in piece carbonizing and to our knowledge there had been no real fundamental study of the process made, most of the information coming from those actively engaged in carbonizing. The difficulties encountered were: tendering, excessive harshness and uneven dyeing, usually called resist spots.

A thorough investigation was made into the process, determining the effect of the numerous variables encountered. The effect of the variables time and temperature in drying and baking, as well as the concentration of the carbonizing agent, in one case sulfuric acid, in the other aluminium chloride, were determined. The specific effect of these variables was checked by ammonia nitrogen determinations which show chemical damage, and changes in dyeing properties. Small differences in dye affinity were recorded by Dr. Hardy's recording spectrophotometer. The effect of moisture was found to be of greater importance than most workers had believed it to be.

So-called resist spots were actually produced and the conditions under which they appeared were noted. The most important factors in such cases were: the concentration of the carbonizing agent on the fabric, distribution whether even or not, amount of moisture, rate and temperature of drying.

Practical Value of Results

Several reports on this research containing the conclusions drawn from the data obtained were published. They pointed out the precautions which should be taken in order to ensure removal of the vegetable matter with a minimum of damage to the wool. There was such a demand for these reports that they were reprinted in pamphlet form and have been widely distributed throughout the industry. At various times we have been informed that this project has proven of considerable value to the industry, in that the information given has made it possible for carbonizers to overcome difficulties ordinarily encountered and improve the quality of their products as well as reducing costs.

Recovery of Wool from Mixtures with Cellulosic Materials

Quantitative analyses of fibre mixtures has always been important, and more so at present, in view of proposed legislation for labeling fabrics as to fibre identification and proportions of each.

The usual method for determining wool in mixtures with cotton or rayon, consisted of dissolving the wool in boiling caustic soda solution, recovering the cotton or rayon, adding an arbitrary correction factor to the cotton content and getting the wool by difference. This is a case where the more valuable component of the mixture is obtained by difference, thus the correction factor which may or may not be correct for any particular mixture, may govern whether or not a profit is made on a particular fabric. It is much more desirable to be able to recover the wool with no correction factor, thus keeping a closer check on the more costly component of a mixture. This factor does not hold in the case of many of the rayons, and where rayon and wool mixtures have become so numerous it is doubly important that the wool be recovered in any system of analysis.

The National Bureau of Standards realized the importance of this matter and developed a method of analysis wherein the wool was recovered. This method was immediately taken up by the woolen and worsted manufacturers and others who were interested. After a considerable number of trials the general opinion was not in favor of this method. First, it was very difficult to obtain reasonably close results on duplicate samples, and, secondly, the procedure involved rubbing the fabric against a screen to remove the vegetable matter, which had been carbonized with aluminium chloride. This phase of the procedure was very injurious to the worker in that the alum tended to cause the fingers to dry and split and also the dust was very irritating to the nasal passages.

Our Research Committee felt that some other more reliable method might be developed and an investigation into the matter was made. A method in which the wool was recovered with no correction factor was developed and tested in a group of cooperating laboratories, with results checking within 1%, which is considered good for this type of analysis. This method removed the cellulosic materials by means of sulfuric acid, a reagent which had been tried by other investigators with no success. The value of this piece of research can be measured by the facts that the Federal Board of Specifications has adopted this sulfuric acid method as a referee method and the American Society for Testing Materials has also adopted it as a standard method.

Determination of Soap Content

At the present time we are engaged in an investigation of extraneous matter in wool. A phase of considerable interest to mill chemists deals with a control method for scouring processes. It is necessary that the soap content of wool be known after scouring in order to forestall trouble in dyeing. The method in use for determining the soap content, removes the soap by extracting the wool with hot alcohol, assuming that the material obtained is all soap. This assumption is unsafe since the same amount of alcohol-extractable material can be obtained from wool cleaned by the solvent process and coming into contact with no soap whatsoever, as from a wool scoured with soap in the conventional manner. Some work has been done on the matter by English workers, but the composition of this alcohol extract has not been determined.

We are actively working on this matter and expect to report on it in the near future. The logical outcome of this research will be the development of a reliable method for determining soap in wool.

The Annual Dinner

THE annual dinner was served in the East Ball Room of the Hotel Commodore at 7 P.M. Members and guests present numbered 124. Seated at the head table with Acting President, Dr. E. H Killheffer, who presided over the after-dinner speaking, were the following guests: Franklin W. Hobbs and Frank D. Cheney, directors of The Textile Foundation; W. Ray Bell, president, Association of Cotton Textile Merchants of New York; C. W. Dall, president, National Rayon Weavers Association, Inc.; Dr. Wanda K. Farr, director, Cellulose Laboratory of the Chemical Foundation, Boyce Thompson Institute for Plant Research; Dean Joseph H. Willits of the Wharton School of Finance and Commerce, University of Pennsylvania.

Also present as guests of U. S. Institute were W. P. Fickett, president, Textile Fabrics Association; William H. Gosch, president, National Association of Hosiery Manufacturers; W. J. Matthews, chairman executive committee, National Association of Finishers of Textile Fabrics; E. T. Pickard, secretary, The Textile Foundation. Heads of several of the other 14 leading textile associations, who are co-operating with U. S. Institute's Committee on Economic Research and the Wharton School in the economic research described by Dean Willits and his associates, were prevented by other engagements from attending as guests. The Associated Wool Industries, however, was represented by Walter K. Porzer, general director, and the National Federation of Textiles, Inc., by H. A. Mereness, technical director.

The reception committee for the dinner were the members of U. S. Institute's Committee on Economic Research, of which Fessenden S. Blanchard is chairman. Music and other entertainment were dispensed with because of the recent death of President Garvan. The only decoration was a large bouquet of red roses in his memory centered on the head table.

Mr. Frank D. Cheney, of Cheney Brothers, New York City, and a director of The Textile Foundation, delivered an extemporaneous and glowing tribute to the late Mr. Garvan. He was the last speaker to be called upon by Acting President Killheffer, and his tribute to the departed was based upon intimate association with him when they were undergraduates at Yale University, and later during the period when Mr. Garvan was leading the struggle to build up the domestic chemical and dyestuff industries to their present commanding position.

Acting President Killheffer introduced as the first speaker of the evening Dr. Farr. Her address was illustrated with lantern slides, and although her subject, "Cellulose Analyses," was of a fundamental and highly technical character, she held the close attention of the whole audience. Unfortunately only a brief abstract of her remarks can be published at present, but when the present studies are completed they will be fully reviewed in TEXTILE RESEARCH and other scientific journals. The released outline of her address is as follows:

"The many important properties of cellulosic textile materials are not adequately analyzed through a limited use of the currently available techniques. A necessary approach to an understanding of the more important physical and chemical properties of a given sample is by means of microscopic, chemical, colloid, physical and X-ray diffraction analyses under carefully controlled experimental conditions. General features of this control which are frequently overlooked are a knowledge of the origin, pre-treatment, and purity of the experimental material. Data obtained show a high degree of uniformity and correlation when these factors are taken into consideration."

Dean Willits and his associates, Dr. C. Canby Balderston, Dr. George W. Taylor and Mr. H. S. Davis, were the next speakers called upon. Although their study of Production and Distribution Organization in the Textile Industries is nearly completed, and will be published early next year, Dean Willits stated that they were not ready to make public definite conclusions. Every phase of the study was described, and it was possible by looking between the lines of what was said to infer certain of their conclusions. A very complete outline of their remarks is published in this issue.

The outstanding feature of the speaking program for members of U. S. Institute and for all interested in the future of textile research in this country, was the address of Acting President Killheffer. The title, "What of the Future?" is inadequate, but the complete address as printed in this issue is a very specific exposition of the new plans and objectives which he proposes for the future of textile research in this country. As part of his remarks were addressed rather specifically to The Textile Foundation, he invited Chairman Hobbs and Director Cheney of the Foundation, to comment on what he had said. Both accepted the opportunity and their remarks follow Dr. Killheffer's address.

Progress of Survey of Production and Distribution Organization

By DR. JOSEPH H. WILLITS and ASSOCIATES *

ABOUT a year and a half ago, the Advisory Committee on Economic Research of the U. S. Institute for Textile Research requested the Industrial Research Department to undertake a study of the production and distribution organization of the textile industries. In expressing a desire for an appraisal of the various efforts that have been made to "bridge the gaps" between producers and consumers, the committee pointed out that some of these efforts had failed, but that others appear to have succeeded. The committee felt that it was important for executives to have an unbiased analysis of the factors that seem to make for the success or failure of the vertical type of organization in the textile industries.

The Industrial Research Department reports to the U. S. Institute for Textile Research that the analysis has been made and its findings are now in preliminary manuscript form. Certain questions covering presentation

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are being discussed with a sub-committee of the Committee on Economic Research. The printed report will be available early in 1938.

The study of production and distribution organization is based upon the actual experiences of the textile industries. In assembling the data on these experiences, some 500 interviews were held with executives in all branches of the textile manufacturing and distributing industries. Those in the basic yarn, weaving, and finishing industries were naturally consulted, as well as other executives in such branches as underwear, outerwear, and hosiery. By contrasting the rich experiences of those in the industry certain underlying patterns of the organization of production and distribution have been discerned. They vary with differences in product and with economic conditions, but they show the situations under which vertical organization has been successfully developed, as well as the advantages and disadvantages of the vertical form of organization. The "pros and cons" of vertical organization that appear from the cases provide the central theme of our report.

While the analysis of individual textile cases provided the method used in the conduct of the study, it has not been practicable to present the findings as a series of cases. One of the most striking characteristics of the investigation was the whole-hearted support given the Industrial Research Department by the industry. Intimate details of company experiences were freely discussed by virtually every textile executive who was consulted. Such details form the invaluable basis for general conclusions, but that must not and they will not be revealed. In each instance where the name of an individual company has been even mentioned in the final report, the concern will be consulted.

The basis of our study is the information given by textile concerns as to their own experiences. An underlying pattern of "principles" of organization is not immediately evident from a casual survey of these cases. On the contrary, the results of particular efforts at vertical organization often have the appearance of being rather dependent upon the peculiar circumstances of each case, especially upon the ability of management. Some executives have such extraordinary "drive" and ability as to enable them to succeed where those of a lesser stature would fail. The one who stands head and shoulders above his fellows may sometimes "go against the tide" and make the going look easy. The quality of an individual management may thus obscure the underlying patterns of organization of textile concerns. It has been the general purpose of the study, however, to discern such patterns, and to outline the factors that have caused their development.

It is not the purpose of the study to urge any particular form of industrial organization, but to summarize the actual experiences of the textile industries as an aid to executives in their thinking on the organization problems of their business and of their industry. An economic analysis can be expected to do no more than this and actual decisions remain the responsibility of the executives of the industry.

No progress report to the industry would be complete without particular mention of our realization that the study of the organization of production and distribution has been made possible by the support and co-operation of the textile industry. The opportunity of working in the textile industry is one that is deeply appreciated by the Industrial Research Department. This

opportunity has been made possible by the co-operation of the Textile Foundation and the U. S. Institute for Textile Research. The confidence of these agencies in the Industrial Research Department is a trust that is highly valued. The Advisory Committee on Economic Research has shown such interest in the study as to deserve credit for much of its significance.

Discussion

Following the general statement by Dr. Willits, three associates of the Industrial Research Department, Dr. C. Canby Balderston, Mr. H. S. Davis, and Dr. George W. Taylor, spoke briefly with reference to various phases of the study. Their remarks are outlined as follows:

Dr. C. Canby Balderston

(*a*) *Why a study of vertical organization is of importance to the textile industries.* The subject of vertical organization is considered to be of particular significance because it relates to the question of whether the speculative aspects of textile operations can be minimized by the form of production and distribution organization. No issue, common to all textile industries, is of greater importance. By contrasting the organization forms used for widely different but typical textile products, this study permits each textile industry to have the benefits of the experiences of the others in meeting its own problem.

(*b*) *The scope of our interest in vertical organization.* Vertical organization is often thought of in terms of the actual ownership and operation of the facilities that perform two or more successive processes. Our definition includes not only such direct means of controlling the flow of merchandise, but also various indirect means. These indirect means include such devices as fabric branding and licensing. They are considered as types of vertical organization.

Mr. H. S. Davis

(*a*) *Importance of centering attention upon the major markets.* We have come to feel that vertical organization in textiles is not a matter of industries or fibres but of markets. If there were no markets between the first fibre processor and the last wholesaler there would be no problem of vertical organization. It is the breaks in the flow of textile merchandise occasioned by markets which create the problems for which vertical organization may be a solution.

(*b*) *Discussion of the markets around which interest centers.* The evidence has been organized by markets to show the pros and cons of vertical organization which combines textile and non-textile operation, and which combines various textile operations. The former organization problem is considered in terms of these four product classes: piece goods sold to the garment trades, yard goods for over-the-counter trade, finished consumers' products made in textile mills, and industrial textiles. Vertical organization within the textile industries is analyzed in terms of the yarn markets and the gray-goods markets.

Dr. George W. Taylor

(*a*) *Vertical organization and flexibility.* The major consideration respecting a development of vertical organization is how to control the flow of goods while maintaining an organization sufficiently flexible to meet the necessities of changing economic conditions.

(*b*) Programs by which a vertical organization can be kept flexible. The study has emphasized the various policies respecting vertical organization that have been used to provide flexibility and those that have been unsuccessful. It is believed that knowledge of these experiences will be of value to the textile executives concerned with organization problems.

Remarks of Franklin W. Hobbs, Chairman, The Textile Foundation

"IT is needless to say that any proposition presented by your organization will receive careful consideration by The Textile Foundation. I have never heard of this suggestion until it was made here tonight and know nothing more about it. Of course, you must remember, Mr. Chairman, that The Textile Foundation is a public trust, created by Special Act of Congress, one of the few such corporations in this country—there are only a half dozen—which have been created by Acts of Congress. That Act provided for only five Directors; three appointed by the President of the United States to serve for a term of four years each, and the Secretary of Commerce and the Secretary of Agriculture ex officio. They constitute the entire Textile Foundation under the Act that created it.

"That Act gives that Board certain very definite duties and obligations. I don't know as you know it, but it was suggested to me when your organization was formed that we turn over all of the funds immediately to your organization to administer, and that The Textile Foundation go out of existence. That did not appeal to the Board at that time. We have also under the Act the right to receive money and donations, any kind from anybody, and thus add to the original principal. We have not yet had a dollar from anyone. Industry has sat back and let the Foundation do what it could. Industry has not raised a dollar. They have been very willing to take the money, but industry, as far as I know, with the exception of two or three small things which we helped to finance, has not done a thing.

"A meeting of our Board will be held on the eighth of December. I would suggest that you have a definite proposition to submit in writing before that time. All that I can say tonight is that we will give it careful consideration. You must remember, however, that we have a really very definite and very serious duty imposed on us by Congress and by the President which cannot be lightly set aside."

Remarks of Frank D. Cheney, Director, The Textile Foundation

"I think the proposal which Dr. Killheffer has made is very interesting. I can't, however, add anything at this time to what Mr. Hobbs has said because I know that he expresses very accurately the thought of the Directors in saying that they cannot commit themselves to anything

without having before them a proposal very carefully prepared and without having opportunity to consider it from all points of view. I am sure that when it is presented they will give it their most serious and thoughtful consideration.

"I trust it is not out of place for me to add a few words to the remarks of our Chairman about your President who has so recently and so suddenly been taken from us, for I feel a desire to do so. I knew him from the time he used to beat me running races in college, and have at times since then been associated with him more or less closely in matters connected with his efforts to aid in the establishment of a dyestuff and chemical industry in this country.

"I think our Chairman will agree with me that if it had not been for Frank Garvan that industry would not yet enjoy the position which it enjoys today. He fought for it constantly, tirelessly, fearlessly, with the utmost integrity and with the greatest intelligence. It was largely through his leadership in those days during the World War when we came to realize that we really didn't have a complete dyestuff industry, that our present dye and chemical industry began to come into being. During those days the United States government was reputed to have bought Rhodamine B, brought into this country in the submarine Deutschland, which which to print its 2c postage stamps, and I happen to know that the Medical Department of the United States Army bought from the concern with which I was connected, German-made Brilliant Green for making their biological stains. They had to have that Rhodamine B and Brilliant Green which was made in Germany but which then wasn't made in this country. We were also dependent upon Germany for many pharmaceuticals. We thought we had a dye and chemical industry but we only had an industry which assembled intermediates into a finished product, those intermediates being very kindly furnished us by foreign countries at a cost so reasonable that we wouldn't make them.

"While I do not say that Frank Garvan was the only man who sensed the situation, once he did sense it he attacked it most vigorously and made a tremendous contribution to its successful solution.

"As Alien Property Custodian he was charged with the custody of upwards of 5,000 German dye and chemical patents, patent applications, trademarks and copyrights which were taken out in this country by Germany. He organized the Chemical Foundation, a non-profit organization which purchased these patents for the benefit of the American people, and which licensed American manufacturers to operate under them on a royalty basis, these royalties being expended by the Chemical Foundation for chemical research.

"He was a great fighter, and when I say fighter I don't mean a brawler for he never brawled. He never fought unless there was something worth fighting for. Every cause that he fought for that I have ever heard anything about, was a good cause. It was a cause which benefitted the people of this country and indirectly benefitted more or less everyone in this room. I would like to propose that we rise for a moment and pay our silent tribute to this man to whom I think this country owes so much."
(*The audience rose and stood in silent tribute.*)

What of the Future?

DR. ELVIN H. KILLHEFFER *

IN 1929 a few men of vision acted on what had become a definite conviction. In their best judgment, based by the way on many years of practical experience in their industry, there was a great need for an institute devoted to the chemistry of their product, paper. There were in existence many schools where courses were given on the technology of paper but excellent as many of these were, they did not fill the need visualized by this band of zealots.

Determined to make a start in spite of all obstacles, three men devoted all of their time, energies and abilities to the founding of what would be both a research institute and a graduate school.

Sixteen paper mills subscribed to a budget of $40,000 per year for five years.

Dr. Otto Kress established a laboratory and with one student assistant began to work out a systematic plan which was also a course of study. Mr. Westbrook Steele devoted himself to work of organization and financing. Mr. Ernst Mahler of Kimberly-Clark was the continuing inspiration and guide of both.

Thus began an effort which today, as the Institute of Paper Chemistry, has a staff of about 70 and a student body of 50 and an annual budget of around $300,000. Sixty-two paper mills are subscribing members.

A visit to the Institute of Paper Chemistry makes a deep impression in several ways: First, one is impressed throughout by the seriousness of the activity. There is no purely academic approach to the subject. It is science at its best, teamed with practice at its best and with the economics of the whole operation in close and careful control.

Next, one is thrilled at the completeness of equipment for study, both scientific and practical. And then as you comprehend in some measure the requirements for admission as a student and the further requirements while a student, your respect and admiration increase materially.

None of this just happened nor was it created or brought to its present state of perfection in a short time. Men who were at once evangelists and crusaders had to live with it constantly. They had to believe in the value of the effort to the point of self-sacrifice.

Now 15 students each year are accepted. These are carefully selected graduates from various colleges. Four years of continuous work and study lead to a Ph.D. As a reservoir of trained men, it is unable to supply the demand.

Unfortunately it has no endowment. Its budgets are currently raised, each subscribing mill agreeing, by contract, to pay for three years an amount per year based on its tonnage capacity but in no case less than $1,000 a year.

Run as it is on a current basis there is one unhappy result and that is a maximum of effort on applied research and a minimum devoted to fundamental research. There is, in other words, a constant demand that year by year the Institute demonstrate its value in dollars and cents to the industry it serves. Every year more of the paper industry are sold on its

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value, and the phase of applied research and trouble-shooting as the major effort will undoubtedly pass so that more fundamental research will be expanded.

Is there here an apt illustration of a workable plan for the textile industry? I think there is. There are many close parallels. We have in the first place, an industry in which there had been little change over a long period. Processes were based solely on past experience with, in fact, comparatively little understanding of the why and wherefore of them. There was scattered educational effort which neither went far enough nor achieved too great a tie-in with practical operations.

When the plan for an Institute was first launched, it met with the opposition and suspicion of most of the paper industry. Fathered as it was by a leader in one of the largest paper mills, the charge was made that it was a device which would be of great benefit to that one company. Others said it was a purely sectional thing without significance or value to the whole industry. Others said the results obtained would not be worth their cost.

Many of these early objections are still raised by many so that a continuous effort is necessary to sell the idea to a greater number. But the Institute itself, the work it does, the men it graduates, and its promises for the future in both fundamental and applied research, is in my opinion a complete answer and justification.

Now, as you see, many if not all of these conditions exist in the great textile industry, an industry in which many of its leaders know full well both the need for and the future importance of research progress. In the aggregate, the textile industry could well afford an institute similar to the one described.

The United States Institute for Textile Research exists for the promotion of fundamental research by and for the textile industry but only the fact that The Textile Foundation and the Chemical Foundation have helped finance has kept us going. That is not too pretty a picture. In our several research projects now in progress, an individual mill contributes $100 in order to get the results of a five- or ten-thousand dollar research.

Are we to believe that the textile industry does not have faith in the value of fundamental research?

Does it mean that they do not believe in the value or the possibility of co-operative research?

Or does it mean that they believe in it only to the extent that someone else will finance it?

Perhaps there is no way of knowing what the collective mind of the industry is on the first point. We can in all truth say, however, the progressive leaders in the industry fully recognize its value.

As to the value of co-operative research, it seems self-evident that in an industry divided into so many units, some large, some small, it is quite impossible for any one unit to undertake fundamental research to any but a very limited extent. It would seem therefore that if there is to be any wide-spread activity in this direction it must be co-operative.

Unfortunately, the last question has a very considerable basis in truth. The industry as an industry has done very little in the way of fundamental research. Many of its greatest progressive developments, both in machinery and processes, have been brought to it, which means that the work has

been done for it by someone else. Somewhat the same condition exists now, for the work supported by The Textile Foundation is done for the industry but is not directly supported financially by the industry.

Some of us feel that we should take account of ourselves and of the whole picture of textile research in order to determine where we are to go from here. There is much textile research in progress today. It is still, however, very greatly scattered and undoubtedly there is considerable duplication. Most of the value of a research group working together is therefore lost. And of still more importance, there is no opportunity of conducting a graduate school with all the promise it holds for the future of the industry. The Institute of Paper Chemistry is affiliated with Lawrence College, a comparatively small institution. The President of the College is one of the Trustees of the Institute. Much that the Institute would need to provide if existing entirely separately, the College provides and each adds prestige to the other.

What I propose to you is this: Establish a textile research institute in connection with a small centrally located University. Equip it with a complete library and general research facilities. Staff it with the very best men obtainable, though initially limited in number. Concentrate textile researches at this one point through the admission of Fellows supported by individual or groups of textile units. Provide for post graduate work by the graduates of existing textile schools and colleges, enabling such students to work to their doctorate.

Special researches conducted for the sole benefit of those who pay for them. Financial support guaranteed through a scheme of proportional assessments based on some factor—sales, for instance, or capacity if that is a better measure.

At such an institution the textile industry could carry on fundamental research co-operatively. Any unit or group could also carry on applied research. The institute could and would supply trained men and women, trained not only in the sense that they would know all of the then known facts but trained in research and its technique.

Why the suggestion of a small, centrally located University? Where it is not too large there are not likely to be other overshadowing distractions. An institute such as we are here picturing would be an important part of the University. Being so connected, much duplication of facilities and expense could be avoided and the conferring of degrees made possible.

Lehigh University or the University of Delaware might be suitable as location. Certainly everything else being satisfactory, it would be neither New England nor South. It would be separate and distinct from any existing center of textile education. There would seem to be definite advantages in avoiding even the possibility of sectional or other jealousies.

Much equipment could and would be donated, as is the case at the Paper Institute.

What finer monument to the foresight of the present directors of the Textile Foundation than the establishment and endowment of such a permanent institution which through the years could carry on in the field of fundamental textile research and in its very activity constantly provide highly trained men as an important by-product of the research activity.

The Textile Foundation knows that one of its greatest contributions to and for the industry is well qualified men. As a result it has sponsored

conferences of the leading textile educators of the country. This is fine. It means better courses which in turn mean better graduates.

What we are here recommending is something that goes further. The education provided by the existing schools and colleges is the preparation for the Research Institute here visualized. If the textile leaders, who fortunately are also the directors or trustees of the Textile Foundation, would, after careful examination of this plan, decide to launch it, using a part of their funds to do so, I believe that individual mill subscribers would be much more readily obtained. To start modestly and to build carefully and soundly are all important.

All of the valuable experience of the Institute of Paper Chemistry is at your disposal.

I leave this with you, with the earnest plea that you will give it very serious consideration.

"Advances in scientific knowledge make ever more onerous the task of schools of science, medicine and social studies in keeping abreast of the needs of an age of rapid material and technical development, and in making adequate provision for advanced studies and post-graduate research."—**Editorial in** *Nature*, **Mar. 27, 1937.**

Tests for Mechanical Properties of Yarns*†

By HERBERT F. SCHIEFER

Abstract

Tests for mechanical properties of yarns, including breaking strength and elongation by four different methods, size, and twist are discussed. Special emphasis is given to the interpretation of the results obtained. The factors of speed, capacity, and rate of loading of the testing machine, yarn structure, and calibration of machines are briefly considered and the field of application and limitation of the tests are indicated. Brief references are made to miscellaneous or special tests for diameter, lustre, coefficient of friction, repeated loading, resilience, and torque relaxation.

Introduction

VARIOUS tests are made on yarns for the purpose of determining the suitability of the yarn for a given use, the conformance of the yarn to definite specifications, in order to control the quality of the yarn during manufacture, or in the development of new types of yarns having superior or specific properties. Obviously a test which may be adequate for one purpose may be entirely inadequate for another. In this paper tests for some of the mechanical properties of yarns will be considered with special emphasis on the interpretation of the results obtained and to indicate the field of application and the limitation of the tests.

It may be well to consider for a moment the scope of the term "yarn." In general, a yarn is a material made from a mass of numerous short fibres of unequal lengths or of continuous fibres, which are twisted together to form a continuous strand for use in weaving, knitting, and other purposes. Because of the great variability of the individual fibres lack of perfect control in each of the numerous operations from the fibre mass to the finished yarn, and atmospheric variations during manufacture, the final product is apt to be non-uniform with respect to weight per unit length, diameter, amount of twist, breaking strength, elongation, in fact with respect to any mechanical property of the yarn which may be determined. An appreciation of this non-uniformity of yarns is essential for the selection of an appropriate test for a given use of the material, adequate sampling, and proper interpretation of the results obtained.

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Breaking Strength and Elongation

Breaking strength and elongation will be considered together since they are usually determined simultaneously.

The breaking strength of a yarn is probably determined more frequently for use as a criterion of quality than any other mechanical property. Four methods are commonly used, namely: single-strand, multiple-strand, skein, and "continuous length."

(*1*) *Single-strand.*—In the single-strand method the breaking strength of the yarn is ordinarily determined for specimens 10 inches in length, that is, 10 inches between the clamps of the testing machine. Two types of testing machines are generally used. One is the familiar pendulum type and the other is the incline plane serigraph which has recently come into use.

In the pendulum type of machine the clamps are usually separated at the rate of 12 inches per minute at no load. Autographic means are provided for recording the load and elongation throughout the test. In modern machines of this type the breaking load and elongation at rupture are also indicated directly on two independent scales. This permits making many more tests in a given time than with machines in which these values are determined from the recorded load-elongation graphs. In operating this type of machine at a constant speed, which is general practice in textile testing, the time rate of loading of a yarn is variable and not controllable during the test because it depends not only upon the capacity and the speed of operation of the machine, but also upon the size and the intrinsic relation of the stress to the strain of the yarn. Thus the time rate of loading depends in effect upon such factors as the amount of twist, kind and quality of fibre, and mechanical or chemical processing, such as carding, combing, mercerizing, slashing, and bleaching, since they affect the intrinsic relation of the stress to the strain of a yarn. However, this type of machine can be equipped with a special speed control, similar to that described by Stang and Sweetman,[1] which makes it possible to test yarns and other materials at predetermined constant time rates of loading throughout the test.

In the incline plane serigraph type of machine the load and elongation are recorded on a chart. No means are provided for indicating directly the breaking strength and elongation at rupture on independent scales. With this type of machine, however, the time rate at which the yarn is being loaded may be controlled during the entire test. This feature is very important in testing yarns since the breaking strength and elongation at rupture depend upon the time rate of loading.[2] However, in using this type of machine of a given capacity and operating it at a given speed the time rate of loading per unit size, that is, weight per unit length of the yarn, is not constant but decreases with the size of the yarn. Hunter, and Scroggie and Castricum have shown that this factor produces an appreciable effect on the results of rayon and cotton yarns and suggest that this type of machine be operated at a constant time rate of loading per denier of the yarn. This necessitates changing the capacity of the machine in accordance with the denier of the yarn.

It is frequently assumed, although contrary to fact, that the breaking strength of a yarn is proportional to its size, that is, weight per unit length. Thus a 20s cotton yarn, for example, has a breaking strength more than twice that of a 40s yarn spun from the same cotton fibre. In testing

these two yarns on a pendulum type of machine, using the same capacity and speed, the time rate of loading of the 20s yarn per unit size, weight per unit length, is less than that of the 40s. As a result of the effect of this factor, the breaking strength of the 20s yarn should be less instead of more than twice that of the 40s yarn. The observed increase in breaking strength per unit weight of the yarn has been attributed by the author[2] to the relative change in the ratio of the circumference of a yarn to the area of its cross-section. This ratio is smaller in coarse yarns than in fine yarns, thus indicating that a greater percentage of the total number of fibres are completely embedded in the coarse yarn and contribute to its strength, or a smaller percentage of fibres are exposed at the surface where they cannot effectively contribute to the strength.

According to data published by Hunter the reverse appears to be true for rayon yarn. Namely, the breaking strength in grams per denier is decreased as the denier of the rayon yarn is increased, using the same capacity for the incline plane serigraph type of machine and operating it at the same speed. Part of this decrease is attributable to the decrease in the time rate of loading per denier in testing the heavier yarn. A smaller but significant difference still remains, however, even when a constant rate of loading of four grams per denier per minute was used. This latter difference unquestionably results from the non-uniformity of the filaments and the greater number in the heavier yarn. A parallel explanation of this is given later in connection with the multiple-strand test for yarns.

Tests made on yarns of similar materials but of different sizes using a constant rate of loading per unit size per unit time, as recommended by Hunter and by Scroggie and Castricum, yield results which are more nearly comparable than tests in which the rate of loading per unit size per unit time is not taken into consideration.

In making single-strand tests for elongation it is important that the specimens be mounted with a uniform and small initial tension. This may be accomplished by clamping the specimen in one pair of jaws and suspending a small weight on it before clamping it in the second pair.[1] When a pendulum type of machine is used, it is convenient to have the pawls disengaged at the vertical position of the pendulum, zero load, and to apply just enough tension in mounting the yarn specimen to cause the pendulum to deflect slightly from its equilibrium position. It is also important to clamp the ends with sufficient pressure to prevent slippage of the yarn in the jaws and yet not to damage the yarn.

The results obtained with the single-strand method, by either type of machine, give not only information regarding the average breaking strength and the average elongation at rupture, but also information regarding the uniformity of the yarn with respect to these two properties. For some purposes information regarding the uniformity of the yarn may be more important than the average breaking strength and elongation. In weaving, for example, several thousand strands of a yarn in the warp sheet are subjected simultaneously to substantially the same extension. If all of the strands had the same extensibility then it is likely that no trouble would be encountered during weaving. However, if some of the strands have extensibilities very much lower than the average, as is the case for the 100 single-strand breaking strengths and elongations of the three 80s cotton yarns of different twist multipliers which are plotted in Fig. 1,[3] it is apparent that in the weaving operation the strands of low extensibility will

carry loads which are proportionally greater than the average, when expressed as percentages of their breaking strengths. Such a condition is likely to cause frequent breakages of the yarn during the weaving operation. The irregularity of a yarn with respect to a given property is conveniently expressed by the coefficient of variation, which is equal to the standard deviation divided by the average value.

For uses where uniformity of the breaking strength or elongation of the yarn is of prime importance, the single-strand test is valuable to the manufacturer for quality control and in the development of special or superior yarns, and to the user of yarn in determining whether or not the yarn he purchases conforms to his requirements and specifications. A disadvantage of the single-strand method is that many tests are required for

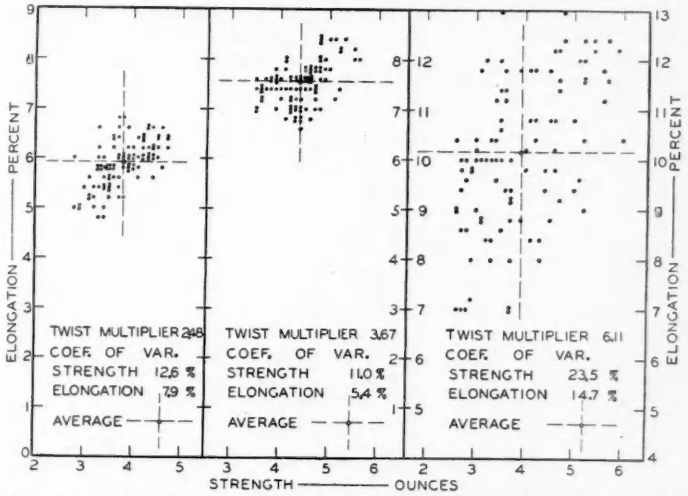

FIG. 1. Scatter diagrams for three twist multipliers of 80s cotton yarns.

statistical studies and to determine an average value adequately. For purposes where an average value is sufficient the multiple-strand or skein methods suffice and are more convenient.

(*2*) *Multiple-strand.*—In the multiple-strand test, described by Schoffstall and Hamm,[4] usually 100 strands are wound parallel to each other on a special split frame and under a small constant tension. The strands and frame are clamped in the jaws of a testing machine, the jaws being four inches apart and separated at the rate of 12 inches per minute at no load. The load and elongation are recorded on a chart. As the load is applied, all of the strands are extended equally and the one having the lowest extensibility is the first to break. Its load is then immediately transferred to the remaining strands. After a small number of the strands have been ruptured, say 10%, the rupture of an additional strand will cause some of the remaining strands to break in rapid succession without requiring a further increase in load. This maximum load is carried by a

fraction of the initial number of strands, most of which are still carrying a load considerably below their breaking strength. In dividing the maximum load by the initial number of strands an average value per strand is obtained, which is necessarily less than the average value of an equal number of single-strand tests. Also the elongation at the maximum load is less than the average of an equal number of single-strand tests. However, it is possible to determine standard values of breaking strength and elongation by the multiple-strand test, for the various types of yarns, to be used for purposes of comparison and quality control during manufacturing. A change in the rate of loading, by using machines of different capacity and speed of operation, or by changing the initial number of strands for the tests, affects the results obtained, as in the single-strand test. This test has been used in a study of the effect of twist on certain properties of rayon yarns.[5] It has also been modified for determining the load-elongation curves of yarns in a wet state.[6]

(*3*) *Skein.*—In the skein method 120 yards of yarn consisting of 80 loops, each 54 inches in circumference, are taken for test. The 80 loops are placed over two drums of the testing machine in the form of a narrow band about one inch in width. The centers of the two drums are approximately 25 inches apart. A certain amount of movement and adjustment of the individual loops during the test can be made. The load on the skein is distributed among the 160 strands of the 80 loops. The distribution of the load depends chiefly upon the extensibilities of the individual strands and would be uniform if all of the strands had the same extensibility. Since the latter is never true for textile yarns, the strand having the lowest extensibility will be the first to break. The two loose ends in effect eliminate two strands from the skein and the load which they carried is transferred to the remaining strands. It is readily seen that after several additional strands are broken, the load will soon reach a value such that the rupture of an additional strand is sufficient to cause many of the remaining strands to break in rapid succession and others to slip over the drum because of the numerous loose ends. The maximum load which can be placed upon a skein is thus very much less than the sum of the single-strand breaking strengths of 160 strands, and the average value per strand is also less than the average value per strand by the multiple-strand method.

Based upon years of experience with this test method the spinners use the skein breaking strength to determine whether or not the yarn compares favorably with the skein breaking strength of the same size of yarn having the same amount of twist, quality of fibre, and process of manufacture; that is, whether combed or carded yarn. For this purpose the empirical formula of Campbell,[7] derived from an extensive statistical study, should be very useful for converting the skein breaking strength of a cotton yarn of one size to that of another size. This formula takes into consideration the fact that the breaking strength is not directly proportioned to the size of the yarn and is an improvement over the linear transformation formula specified in A. S. T. M. Designation: D180–361.

The skein test is used mainly for determining the average breaking strength of cotton, woolen and worsted yarns, and for ordinary spinning comparisons this test method is adequate and sufficient. For purposes where uniformity of the yarn is of prime importance this test is of little value. An advantage of this method is that the skeins which are used for the breaking strength tests may be weighed and the sizes of the yarns determined.

The relation between the average results for breaking strength and elongation by the above three methods of test is indicated in Fig. 2[3] for cotton yarns having different amounts of twist. The ratio of the multiple-strand or skein result to the single-strand decreases as the amount of twist is increased. This decrease has been attributed to the observed increase in irregularity with an increase in the twist. (See Fig. 1.)

(4) *"Continuous Length."*—In the "continuous length" method the yarn is passed continuously through the testing machine, such as the Frenzel-Hahn type,[8] under either a predetermined tension or elongation. The

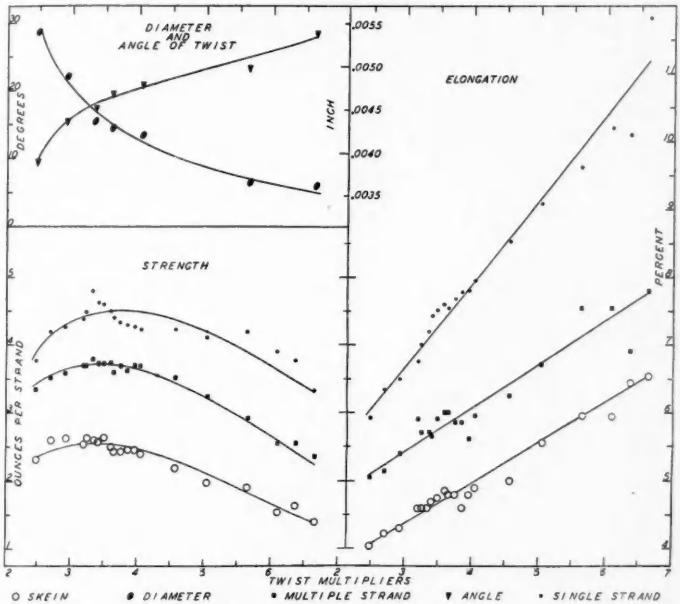

FIG. 2. Effect of twist multiplier on the breaking strength, elongation, diameter, and angle of twist of the 80s cotton yarn. The difference in results obtained by the three methods of determining the breaking strength and elongation are also shown.

tension or elongation selected is considerably below the average value at rupture. The number of breaks per unit length of the yarn and the variation in elongation for the given tension or the variation in tension for the given elongation are recorded. It is claimed that this test is useful in determining the uniformity of the yarn, and whether or not the yarn contains portions having low strength or elongation such as are likely to cause trouble in weaving. It is necessary, however, to know in advance of the test the predetermined tension or elongation to which the yarn of given size and kind of fibre shall be subjected if the test is to indicate the

likelihood of satisfactory or unsatisfactory performance of the yarn for a given use.

In tests, such as breaking strength and elongation, in which the results on similar yarns when tested in different laboratories and on machines of different capacity and type are to be compared, it is important that the tests are made not only by the same procedure but that the testing machines are properly calibrated and used only for the range in which the machines conform to specifications.

The calibration of the pendulum type of machine for yarns is readily carried out by means of dead weights, which should be the preferred method whenever it is possible to apply it. For the incline plane Serigraph type of machine for yarns, the use of dead weights alone is not feasible. Cleveland has made a critical study of two methods of calibration of this type of machine.[9] The results by the two methods are in good agreement. He discusses their relative merits and indicates certain limitations of this type of machine, which should be taken into consideration in the interpretation of the results obtained with it.

Size

As is well known, the methods of designating the size of textile yarns vary with the kind of fibre from which the yarn is made. Basicly two entirely different systems are used. The one system is based upon the length per unit weight, in which the finer yarn is designated by a larger number, while the other system is based upon the weight per unit length, in which the coarser yarn is designated by the larger number. The size designation is complicated still further by the various units which are used in each of the two systems. The "typp" count, indicating the number of thousand yards per pound, suggested as a uniform designation for all yarns, regardless of the kind of fibre of which the yarns are made, has many advantages over the other systems, and its adoption and more general use should be encouraged.

A standard method of designating the size of ply yarns should be adopted. The designation of 60/2 is interpreted to mean a 60s yarn made from two yarns of finer count[10] or it may indicate a yarn equivalent to a 30s made from two yarns of 60s. The designation of 2/60s, which is also frequently used, is less ambiguous in that it definitely suggests two yarns of 60s. The designation becomes still more confusing for coarse yarn of higher ply, such as 23/11 ply (A. S. T. M. Designation D122–33) and 23/5/3 (A. S. T. M. Designation D298–29). Presumably the former yarn is made from 23s instead of 11s single yarn. The addition of an "s" after the 23 would clarify the designation, especially for coarse yarns such as 8s/6 (6/8s) and 8s/4/3 (3/4/8s).

Twist

(*1*) *Amount.*—Two methods are used for determining the amount of twist in yarns. In the one method a given length of the yarn is mounted under an initial tension, depending upon the size, and the number of turns of twist are determined by removing the twist from the yarn. The chief difficulty with this method is that there is no critical end point for single yarns which are spun from short fibres. It appears entirely satisfactory for ply yarns and single yarns made from continuous or long fibres.

In the second method the amount of twist is determined by first un-

twisting the yarn and then retwisting it in the opposite direction until the yarn has contracted to its initial length. The assumption that a single yarn will elongate and contract an equal amount for a given number of turns of twist when untwisted and retwisted in the opposite direction is questionable. It is obvious that the initial and final tension, as well as the tension during the untwisting and retwisting, and frictional forces would greatly influence the results obtained. The effects of applying a constant tension during untwisting and retwisting, the magnitude of the tension as a function of the yarn size, frictional forces, a decreasing tension during untwisting and an increasing tension during retwisting, and accuracy of the length measurements have not been fully investigated.

Frenzel [11] has studied the changes in the lengths of ply yarns during twisting and untwisting. He used a twist counter which automatically records the change in the length as a function of the amount of twist. His curves indicate that the change in length, whether a decrease, or an increase and then a decrease as the ply twist is increased, depends upon the amount and the direction of the twist in the component yarns. Fortunately the ply twist of a yarn is readily determined without using the second method.

(*2*) *Direction.*—The confusion regarding the direction of twist has been very largely eliminated by the introduction and acceptance of the "S" and "Z" twist designation. The universal acceptance of this designation as applied to single and ply yarns should be encouraged.

Miscellaneous

Under miscellaneous tests of yarns may be grouped those physical tests reported in the literature which have been used in connection with special researches, usually using equipment of special design. Since these tests are too numerous to be described and discussed in detail in this paper, only a very general and incomplete discussion is possible to indicate the field and scope covered by them.

Measurements of the diameter of yarns and variations in diameter have been made by mechanical, optical, electrical, photo-electrical, and other methods. Some of these methods employ mechanical means, such as levers, which are actuated by the variations in the diameter. The amount of movement is magnified by mechanical or optical means. Other methods employ changes in the amount of light transmitted to a sensitive element, such as photo-electric cells or thermo-elements, when the yarn is passed through a beam of light of constant intensity. Also the changes in electrical resistance of a column of mercury, through which the yarn is passed, and changes in gas pressure across a capillary tube, through which the yarn is passed, have been used to measure the variations in diameter of yarns. The chief difficulty with these methods has been the fact that only relatively short lengths of the yarn could be measured in a reasonable time. Also no satisfactory method has been developed for evaluating the diameter variations from the graphs. The Huber Evenometer, which has been described by Huber in his paper on tests for fibres, is a great step forward and no doubt could be developed for yarns in general.

Methods for measuring the coefficient of friction of yarns have been devised by Sellars [12] and by Saxl.[13] These methods have been used successfully to indicate the effect of various factors on the coefficient of friction of yarns. Studies of the effect of repeated loading and unloading of yarns have been made by Seem [14] and by Stirm and Zeoppritz.[15] The deter-

mination of the flexibility of yarns has been considered by Saxl[16] and by Rogokina and Lasarewa.[17] Methods for the measurement of the lustre of yarns have been published by Hunter[18] and Ranshaw.[19] Harris and Smith have employed the compressometer for measuring the effect of chemical treatments on the compressional resilience of wool yarns.[20] A detailed study of the relationship of torque relaxation and torsional energy to the character of the pebble in rayon crepe has been made by Steinberger.[21] These special test methods and investigations are illustrative of the work which is being done to obtain a better understanding of the properties and use of textile yarns. They hold the key to the development of new types of yarns, having improved properties to facilitate the manufacture of fabrics more economically and of special or superior qualities.

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Address, C. H. Clark, Sec., 65 Franklin St., Boston, Mass.

I. Fibres (Synthetic and Natural) and Fibre Analysis

Biological Studies on South African Merino Wool Production. Victor Bosman. *J. T. I.*, 1937, Aug., P. P270–P306; Sept., P. P321–P53.

A thesis approved for the degree of Doctor of Science by the University of South Africa. Previous investigators have mainly dealt with breeds of sheep other than the merino. The present investigations are confined to the South African merino. The problems have been studied from biological aspects and an attempt has been made to analyze some of the factors which control wool production. In the first part, methods for determining the fleece characteristics are described. The second part deals with production and describes the interdependence of the fleece characteristics, and the weight of wool produced. It also discusses the stress that fleece characteristics deserve in sheep selection, and describes experiments that deal with nutritional and other environmental influences. The third section describes the fibre fineness of South African wool, while in the fourth section the fleece analyses of merino stud sheep are discussed from a statistical standpoint.

Laboratory methods that are most suitable for routine analysis of merino fleece characteristics are described. The importance of precise arithmetical expressions for fleece characteristics is emphasized. It is shown that fleece density is dependent on the number of fibres growing per unit area of skin as well as on the fineness of the fibres. A formula is

given by which the scoured fleece weight can be calculated:

$$W = LAdns.$$

Where W is fleece weight, L, fibre length, A, cross-sectional area of the fibres d, specific gravity of wool, n, number of fibres grown per unit area of skin and s, total skin area of the sheep. The merino slide rule, whereby fleece characteristics can conveniently be compared in relation to wool production, is described. The stress that each fleece characteristic deserves in sheep selection is established. An unusually complete bibliography is appended. (C)

HEAT CONDUCTIVITY OF TEXTILE FIBRES. *Mell. Textilber.*, 1937, No. 9, P. 684.

This article first describes a new process of accurately measuring the heat conductivity of textile fibres. Comparison by this method of packages of wool, Wollstra, Vistra, and undulled rayon, all of the same density, showed that the heat conductivity is practically identical in each case. The heat conductivity of cotton and pigmented dull rayon is about 30% higher, and that of real silk and acetate rayon is about 10% lower. Comparison of packages of the same size reveals great differences, when the results are not calculated on the same density. Rayon permits of the passage of about twice as much heat as wool, standard Vistra about 25% more; Wollstra and Vistra XT show no difference compared with pure wool. These facts indicate that differences in the heat conductivity of textile materials are unimportant as far as the retention of heat is concerned, and that the decisive factor is the ability of a fibre, when woven or knitted, to form structures of low density, that is to say, to produce loose textures. (C)

RAYON PULP MANUFACTURE: PROGRESS IN. C. L. Moore. *Rayon Tex. Mo.*, 1937, Sept., P. 72–4; Oct., P. 66–8.

A series of articles presenting the European viewpoint on the subject. (C)

STRENGTH OF CELLULOSE FIBRES AND THE EXTENT OF THEIR POLYMERIZATION: CONNECTION BETWEEN. H. Staudinger, M. Sorkin and E. Franz. *Mell. Textilber.*, 1937, No. 9, P. 681.

There is not only a cellulose series, but also a polymeric homologous series. The physical properties of cellulose of different degrees of polymerization show great differences. It has been brought out by the experience of the rayon industry that the strength properties of material containing cellulose is not directly proportional to the degree to which the cellulose has been polymerized. The strength of a thread does not depend solely upon the length of the molecules present, but also upon the way in which they are assembled in the solid cellulose. The authors have now determined the resistance to breaking by bending, the breaking strength, and the elongation as a function of the degree of polymerization. Cotton is not tendered appreciably when the cellulose content is decomposed to a polymerization degree of from 700 to 800, and it is not until the degree of polymerization has reached 600 that its strength falls off considerably. Rayon in which the cellulose has been polymerized to 500 may show arti-

ficial strength properties; at a higher degree of polymerization only the resistance to breaking by bending is improved. The production of very highly molecular rayon involves great difficulties. (C)

VISCOSE RAYON INDUSTRY: CAN COTTON ENTIRELY REPLACE WOOD PULP IN THE? *Rayon Tex. Mo.*, Sept., 1937, P. 75–6.

Explains technically why more cotton linters are not used for the manufacture of viscose rayon. (C)

II. YARNS AND FABRICS

ACETATE RAYON TECHNOLOGY: RECENT ADVANCES IN. A. H. Pettinger. *Rayon Tex. Mo.*, Sept. 1937, P. 70–1.

Outline report of recent foreign and domestic patents covering the following subjects: The dyeing of acetate rayon; wet strength; ladder-proofness; action of light; electrical conductivity; insulating properties; oil removal. (C)

AIR CONDITIONING FOR TEXTILE PLANTS MAKING AND USING SYNTHETIC YARNS. L. L. Lewis. *Rayon Tex. Mo.*, 1937, July, P. 52–5, 70; August, P. 35–7; Sept., P. 109–10. (C)

NON-ACETATE CHANGES IN WETTING-OUT. Anon. *Am. W. & C. Eptr.*, Nov. 18, 1937, P. 17–8, 28.

Some comparisons regarding yarn stretch and recovery under normal or standard conditions, with tables showing results. (C)

RAYON: PROGRESS IN COMMISSION THROWING OF. Henry Miedendorp, Jr. *Rayon Tex. Mo.*, Sept. 1937, P. 83–5. (C)

RAYON THROWING MAKES AND SOLVES ITS PROBLEMS. *Rayon Tex. Mo.*, Sept. 1937, P. 85–7.

A review and forecast by a practical throwster. (C)

STARCH SIZING OF RAYON WARPS: PROGRESS IN. F. G. La Piana. *Rayon Tex. Mo.*, Sept. 1937, P. 81–2. (C)

SIZING RAYON WITH GELATINE, PROGRESS IN—ITS USES AND ABUSES. W. L. Bentley. *Rayon Tex. Mo.*, Sept. 1937, P. 79–81. (C)

VELVET CONSTRUCTIONS: TECHNIQUE OF TRANSPARENT VELVET. *Rayon Tex. Mo.*, Sept. 1937, P. 90–1. (C)

STAPLE FIBRE FABRICS: CREASE RESISTANCE. K. Quehl. *Textilber.*, 1937, V. 18, P. 241–42; abs. in *J. T. I.*, June 1937, P. A319; *Rayon Tex. Mo.*, July 1937, P. 90.

The causes of the low resistance to creasing of rayon and staple fibre products are discussed and mention is made of the process for improving crease resistance which depends on treatment with a bath containing Preska 110. The treatment imparts wool-like properties to staple fibre fabrics and the effect probably depends on the formation on the fibres of an elastic

outer layer of low degree of orientation. A method of measuring resistance to creasing is described which depends on measurement of the creasing angle. The results of measurements on woolen fabrics and on untreated and Preska-treated staple fibre fabrics are discussed. (C)

SLASHING SYSTEM: NEW. V. E. Dubois. *Am. W. & C. Rptr.*, Sept. 30, 1937, P. 9–10, 18.

Paper delivered by author before Georgia Textile Operating Executives. Describes the Saco-Lowell "co-ordinated unified slashing system" and the resulting improved and increased product. (C)

YARN STRENGTH OF EGYPTIAN MIXINGS. Frank Dunkerley. *J. T. I.*, Aug. 1937, P. T255–T62.

The yarn strength of a 50: 50 mixing of any two Egyptian cottons is near to the average yarn strength of the components spun unmixed. Cottons contribute their undiminished quota to the yarn strength of mixings proportional to the quantities present, however many components there may be to the mixing and whatever the proportions mixed. Even the asymmetrical structure produced by spinning a double roving yarn from odd roving bobbins is equal in strength to the mean of the components. Attention is drawn to the tendency of mixings to be slightly higher in strength than the average of components; it is concluded that irregularity of staple (as distinct from wastiness) is not in itself a cause of weak yarn. (C)

III. CHEMICAL AND OTHER PROCESSING (NOT OTHERWISE CLASSIFIED)

STEAM: ACTION OF—AT DIFFERENT PRESSURES UPON THE BEHAVIOR OF COTTON TOWARD REAGENTS AND DYES. Haller. *Klepzig's Textil-Z.*, 1937, V. 40, P. 273–5; abs. in *C. A.*, 1937, V. 31, Col. 5171. (W)

SUBSTANTIVE DYEING: INTERPRETATIONS OF THE PROCESSES OF. A. M. Patel. *Tex. Col.*, Sept. 1937, P. 593–95. (C)

SUBSTANTIVITY OF DYES: DEFINITION AND MEASUREMENT OF. Paul Ruggli. *Klepzig's Textil-Z.*, 1937, V. 40, P. 271–3; abs. in *C. A.*, 1937, V. 31, Col. 4819.

Substantivity is the difference between adsorption and desorption. Adsorption is detd. as the percentage of the dye originally present in soln. which has been adsorbed by cotton in one hr. Differences in substantivity are much more distinct in coned. than in dil. dye baths. Equal (not equimol.) amts. of dye must be used. For desorption detns. the dyed strand is briefly rinsed in cold water to remove adhering vat liquor and then placed in 100 cc. of distd. water at 100° and allowed to cool to room temp. After 24 hours the dye content of the extd. dye soln. is detd. This amt. expressed as percentage of the total amt. of dye used in the original dyeing expt. is the desorption. For practical purposes the substantivity with Glauber's salt should be at least 15. The literature on the substantivity of various types of dyes as well as colorless compounds is reviewed in detail. (W)

SULFONATED OILS: FRACTIONATION AND COMPOSITION OF. Ralph Hart. *Rayon Tex. Mo.*, July 1937, P. 77–8; Aug., P. 59–60; *Ind. Eng. Chem., Anal. Ed.*, 1937, V. 9, P. 177–80.

A rapid and reliable procedure is given for the quantitative fractionation or separation of the various fatty components contained in sulfonated saponifiable oils. Data obtained as a result of the application of this method to samples of commercial sulfonated olive and castor oils indicate that the reaction between concentrated sulfuric acid and a fatty glyceride is comparatively simple and that no polymers, or very little, are formed. These findings are contrary to the generally accepted view of the sulfonation reaction. The probable composition of each of the fractions separated is given and the probable course of the sulfonation reaction is represented by an equation. (C)

SUPERIMPOSED DYEINGS ON TEXTILES: EXAMINATION OF. J. Lanzer. *Monatschr. Textil-Ind.*, 1937, V. 52, P. 141, 167; abs. in *C. A.*, 1937, V. 31, Col. 6010.

Dyed textiles are redyed in order (1) to render dull tones more vivid (basic dyes over direct or S dyeings), (2) to equalize unequal dyeings (direct dyes over vat dyeings), or (3) to increase the fastness of the dyeing (chrome dyes over indigo dyeings). Detailed directions are given for the chem. detection of such superimposed dyeings. (W)

SYNTHETIC FIBRE COMBINATIONS. E. W. Pierce. *Canadian Tex. J.*, Aug. 6, 1937, P. 36–7.

Abstract of an address delivered at the monthly meeting of the Quebec Section, Canadian A. T. C. C., held on May 15, 1937, in Montreal, giving practical observations on the scouring and dyeing of acetate-viscose mixtures and the dyeing of staple rayon-wool piece goods and slubbing. (C)

SYNTHETIC RESINS AND THEIR APPLICATION AS TEXTILE FINISHES. D. H. Powers. *Am. Dye. Rptr.*, July 12, 1937, P. 397–404.

Paper presented at meeting, New York Section of A. A. T. C. C., April 23, 1937. (C)

TEXTILE ASSISTANTS: THEIR CHEMISTRY AND USE. F. G. Brown. *Tex. Col.*, Sept. 1937, P. 587–89, 636. (C)

TEXTILE BLEACHING. Gordon D. Pratt. *Canadian Tex. J.*, Sept. 3, 1937, P. 32–4, 52.

Describes and discusses new processes and chemicals, features of new bleaching equipment, and the correcting of common bleaching faults and defects. (C)

TEXTILE-CHEMICAL APPLICATIONS OF SUGAR. A. Patterson. *Tex. Col.*, July 1937, P. 462–63. (C)

TIN-WEIGHTING SILK: PRACTICAL SIDE OF. Hans A. Holterhoff. *Am. Dye. Rptr.*, June 28, 1937, P. 358–61.

Paper presented at meeting, R. I. Section A. A. T. C. C., Jan. 20, 1937. (C)

TOXIC ACTION OF CHLORINATED HYDROCARBONS. R. Freitag. *Rayon Tex. Mo.*, Aug. 1937, P. 75–7. (C)

VAT DYES: APPLICATION IN THE UNREDUCED STATE. F. Gund. *Textilber.*, 1937, V. 18, P. 231–32; abs. in *J. T. I.*, June 1937, P. A317.

The development of the so-called Prästabitöl or pigment padding process for the application of vat dyes and practical details of the procedures are discussed. The goods are padded with a suspension of the dye in a finely-divided state, to which suitable wetting and levelling agents such as Prästabitöl V and Eulysin A are added, and then treated with hydrosulphite and alkali, and the dye is finally developed in the usual way. Indanthrene dyes suitable for this process can be obtained in paste form and in the form of fine powders. The method is particularly advantageous for the dyeing of dense fabrics and hard twisted yarns, the penetration and levelness being superior to that obtained by the usual methods. It may be used for the dyeing of cotton, staple fibre and mixture yarns and fabrics (C)

VAT DYE PRINTS: INFLUENCE OF THICKENING AGENT ON COLOR DEPTH. H. Gerber. *Textilber.*, 1937, V. 18, P. 316–19; abs. in *J. T. I.*, July 1937, P. A376. (C)

VAT PRINTING PASTES: A FUNDAMENTAL STUDY OF. II. STUDY OF THE INFLUENCE OF THE METHODS OF PREPARATION OF PRINTING THICKENERS ON THE THICKENING VALUE AND "COLOR YIELD." Sivert N. Glarum. *Am. Dye. Rptr.*, July 26, 1937, P. 437–45. (C)

WOOL CHLORINATION IN WOOL PRINTING: THEORY OF. E. Justin-Mueller. *Mell. Textilber.*, 1937, V. 18, P. 452–3; abs. in *C. A.*, 1937, V. 31, Col. 3289, 6012. (W)

WOOL DYEINGS: FASTNESS OF—TO WET TREATMENTS. III. F. L. Goodall. *J. Soc. Dyers Col.*, July 1937, P. 279–82.

In Part II it was established that addition of a dispersing agent to an extracting solution at 80° C. causes an increased amount of dye removal from acid-dyed wool, and that the effect of such an addition is proportionately much greater with a colloidal dye, *e.g.*, Polar Yellow R conc., than with a molecularly dispersed dye, *e.g.*, Acid Orange GG. Experimental evidence has been produced to show that these findings are also true for temperatures of 40° C. and 0° C., and it is accordingly believed that they apply to all temperatures with which wool is likely to come into contact without suffering fundamental disruption. These results are in conformity with considerations advanced in the present author's previous papers on the theory of wool dyeing. It is noted that, whereas dye removal at 80° C. increases rapidly above pH 8.0, at lower temperatures investigated this rise does not commence until pH 9.5.

IV. *Ibid.*, Aug. 1937, P. 317–24. In previous papers stress has been laid on the effect of pH and of the aggregating or dispersing nature of solutions on their capacity to remove dye from acid-dyed wool. The experimental evidence put forward in this connection provides a useful basis for an investigation of the influence of temperature, which is described in the present paper. (C)

IV. Research Methods and Apparatus

"Flu-Tex" Print Examining Device. Quarzlamp-Gesellschaft m.b.H. *Textilber.*, 1937, V. 18, P. 310–11; abs. in *J. T. I.*, July 1937, P. A375.

A device for control purposes in the application of colorless or faintly colored printing pastes consists of a viewing box, 35 cm. broad and 15 cm. high, provided with a stereoscope-like opening for the eyes, and a lamp producing ultra-violet light attached in such a way that the eyes are protected from direct radiation. Naphthol AS dyes fluoresce in ultra-violet light and "Fluoreszenzsalz" GD and RD may be added to non-fluorescing printing pastes. The device may be used for the detection of doctor stripes and of a covering of the ground with printing color, and also for the control of the repeat on a dark colored ground. (C)

Microscopic Analysis of Mixture Yarns: New Counting Chamber for the. Alois Herzog. *Mell. Textilber.*, 1937, No. 9, P. 693.

The firm of Carl Zeiss, Jena, has succeeded in preparing a counting plate with a glass edge that has been fused on. It has proved to be very useful for the microscopic counting of small sections of fibres; for example, in the quantitative examination of mixture yarns. (C)

Twist Strength. Walter Frenzel and Willy Harzer. *Mell. Textilber.*, 1937, No. 10, P. 774.

The authors describe a testing device, comprising a self-recording twist counter and a Frenzel-Hahn yarn testing machine, for determining the tension produced in a twisted thread of constant length between the clips. The course of the tension exerted by increasing the twist of a two- and three-ply 20's cotton yarn was determined together with the breaking torsion and the breaking strength. It was found that the twist strength is proportional to the number of threads for the same yarn count. The effect of loading on the changes in length when twisting was investigated on the self-recording twist counter and the result is shown graphically for 2/20's cotton yarn. The curves plotted show very plainly that shortening of the twisted yarn is comparatively very much greater with low loads than with high loads. (C)

Yarns: Determining the Turning Moment of. Irving J. Saxl. *Mell. Textilber.*, 1937, No. 8, P. 588.

The author describes a novel apparatus by means of which the turning moment of a yarn can be accurately determined. (C)

Zeiss Lanameter for Measuring the Fineness of Wool. E. Franz. *Mell. Textilber.*, 1937, No. 8, P. 557.

The International Wool Conference dealt exhaustively with the question of the measurement of the fineness of wool and adopted a unanimous Resolution at the general meeting in Warsaw, of which the author presents a summary in this article. The diameter of wool fibres is determined microscopically under a magnification of 500 diameters. A detailed description is given of the Zeiss Lanameter as designed by Franz and Doehner and a number of staple diagrams of wool and staple fibre are shown. (C)

TRIETHANOLAMINE: RAPID METHOD FOR DETERMINATION OF. C. J. Eastland, N. Evers and T. F. West. *Analyst*, 1937, V. 62, P. 261–66; abs. in *J. Soc. Dyers Col.*, Aug. 1937, P. 339.

A method is described for the isolation of triethanolamine from the water-soluble substances of emulsions and other preparations after acidification, use being made of the insolubility of triethanolamine hydrochloride in *iso*propyl alcohol. Triethanolamine can be separated from ethylene glycol, into which it partially hydrolyses under certain conditions, by precipitation with phosphotungstic acid. (C)

SYNTHETIC RESIN MOUNTING MEDIA: APPLICATION. B. F. Skiles and C. E. Georgi. *Science*, 1937, V. 85, P. 367–68; abs. in *J. T. I.*, July 1937, P. A389.

The authors recommend the use of synthetic resins (*e.g.* "Vinylite" and "Pontalite") dissolved in butyl acetate or xylene, as mounting media instead of Canada balsam. (C)

ULTRAMICROSCOPE CELL: APPLICATION IN ELECTROPHORESIS MEASUREMENT. T. B. Lane and P. White. *Phil. Mag.*, 1937, V. 23, P. 824–28; abs. in *J. T. I.*, July 1937, P. A405. (C)

WOOLEN AND WORSTED LUBRICANTS: NEW WAYS OF TESTING. Werner Von Bergen. *Rayon Tex. Mo.*, 1937, July, P. 56–8; Aug., P. 46–7. (C)

V. ECONOMICS, PHYSICS AND MISCELLANY

CELLULOSE: STATE IN SOLUTION. T. Lieser. *Leipz. Monats. Tex. Ind.*, 1937, V. 52, P. 109–111; abs. in *J. T. I.*, July 1937, P. A403.

The author discusses the state of cellulose in solution and quotes results bearing on this problem which have been obtained by various workers. He concludes that solvents can split cellulose into isolated principal valency chains. The process depends on the nature of the solvent, the length of the principal valency chains, the temperature and the concentration. Such molecular solutions can exist in organic bases and in inorganic acids. Solutions of cellulose as viscose are predominantly micellar and solutions in cuprammonium solution are strictly micellar. Celluloses which have been split into isolated thread molecules can recrystallize to micelles which are similar to the original micelles. (C)

CLAY: SOME COLLOID CHEMICAL ASPECTS OF—AS A LOADING MATERIAL. E. A. Hauser. *Paper Trade J.*, Aug. 12, 1937, P. 39–41.

A discussion of the colloidal aspects of clays with particular consideration of particle size and shape and base exchange phenomena. (C)

ORIENTED ADSORPTION AND SURFACE-ACTIVE SURFACES. THEIR ROLE IN THE TEXTILE INDUSTRY. Jean Vallee. *Bull. fédération intern. assoc. chim. textile couleur*, 1936, V. 2, P. 5–24; cf. *C. A.*, V. 30, Col. 8625; abs. in *C. A.*, 1937, V. 31, Col. 4126. (W)